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The Frequency Question Again. MR. STEINMETZ adds another contribution this week to the discussion of the best frequency for alternating currents. He seeks to correct the impression that the low frequency chosen for the alternating current systems on the Continent is an "accidental" circumstance, and at the same time sets forth very fully the reasons that have governed this selection of a low frequency abroad and a comparatively high frequency, three times as great, in central lighting stations in this country, explaining how this circumstance has affected the use of alternate current motors in connection with the distribution of current for lighting purposes.

Patent Law Amendments. IN a brief article printed elsewhere in these columns Mr. George H. Knight calls the attention of electrical engineers who are interested in national legislation on the question of patent law to the opportunity afforded by the postponement to the next session of Congress of Senate Bill No. 3,246, a measure the purpose of which was to bring about certain amendments to the existing patent laws. Mr. Knight desires to call special attention to Section 1 of this bill, which is intended as an amendment to the well known clause by which the limit of a United States patent is made to depend upon the expiration of the earliest expiring previously granted foreign patent for the same invention. He believes that the only proper way in which this clause can be amended is to expunge it.

Fireproof Insulation. MR. FESSENDEN has done a great deal of excellent work in the investigation of various kinds of insulations, and the article which he contributes to this issue outlines a series of experiments and the results obtained when he was connected with the Edison laboratory. The subject is an important one, and is especially timely, since in the discussion now going on in our columns regarding the fire risks of electric lighting much is said about the fireproof qualities of insulation for wires carrying currents of electricity. The desirability of an insulation possessing fire proof qualities has led many experimenters to make very elaborate and expensive researches to find, if possible, something that would meet the demands of electric lighting service, and we hope that others may follow Mr. Fessenden's example and give our readers the benefit of what they may have ascertained regarding the properties of fireproof and waterproof insulations.

Three-Phase Transmission. A SHORT note by Mr. Oscar von Miller elsewhere in our columns, will doubtless be read with considerable interest by many American electrical engineers. Mr. Miller's note is in reply to an inquiry sent him some time ago regarding the actual commercial status of the three-phase motor in Europe. He refers to the difficulty of splitting the current consumed in three-phase transmission into three equal parts as the main objection to the use of the rotary current for this class of work, and to the fact that if uneven distribution takes place considerable difficulty is experienced in regulating the pressure in the three branches of the conductor. Besides this the additional expense caused by the three cables instead of two has induced European engineers, as Mr. Miller points out, to prefer the ordinary alternating current system wherever it is possible to apply it in practice. Experiments are being made by some of the principal electrical engineering firms of Germany with ordinary alternate current motors which have promised to be so successful that in one plant which Mr. Miller has recently constructed he has specified the use of this type of alternating current motor for a central station which derives its power from a waterfall seven kilometres distant from the point where the current is applied to the motor.

Electrical Railway Litigation. WE print elsewhere in this issue the first installment of an article on this subject written by Mr. Ralph Stone, the editor of the *Michigan Law Journal*. The increasing use of electricity for industrial purposes has made questions of this nature one of the most important branches of the law. In the operation of electric railways, in the management of electric light plants, in the prosecution of the telegraph and telephone business and in many other similar but not less important branches of electrical application questions are daily arising regarding the authority, the rights and the liability of the parties concerned. On this account the comprehensive treatment of the question by Mr. Stone will prove a valuable contribution to the literature of the subject. He has chosen to consider particularly the legal aspects of the electric railway, and he discusses the subject as to the authority of the electric railway to use the public highway; the rights of owners of abutting property against the electric railway; the liability of the electric railway to the telephone company for alleged interference of the former with the proper use of the telephone by leakage and induction, and the liability of the railway company for injuries to third persons. That part of Mr. Stone's paper printed in this issue gives only his treatment of the first of these divisions of the subject, while the discussion of the second, third and fourth, which are no less important in their nature, will be given in a subsequent issue.

Electrical Standards. THE elaborate communication presented by Dr. Oliver Lodge to the British Association Committee on Electrical Standards, and reprinted elsewhere in this issue, will prove of great interest to those of our readers who have from time to time taken a hand in the discussion of the names and the magnitudes of the various electrical units in practical use at the present time. Dr. Lodge's communication deals principally with the units which concern the magnetic circuit as distinguished from those which belong to the electric circuit. The latter he considers to be well provided for, although one or two improvements in existing units are suggested. The author rightly considers that practical men would do well to insist that names shall be given to the complete things dealt with rather than to the mere coefficients. Many of the modifications of existing units as proposed by Dr. Lodge are not new, as these changes have been advocated by different writers on the subject for many years. The paper, however, is an admirable summary of the present condition of the science of electrical units and brings together in concise form the modifications which he considers advisable.

The History of Electricity. IN our present issue we begin the publication of Part II. of Mr. P. F. Mottelay's History of Electricity, Galvanism, Magnetism and the Telegraph. Part I. of this elaborate treatment of the history of electricity was published in various issues running through the months from April to September, 1891, and covered very completely the history of the science from B. C. 2637 to A. D 1820. Part II, which we begin in our columns this week, takes up the history with the year 1800, when Volta announced in a letter to Sir Joseph Banks his great discovery of the galvanism. As is well known, the period immediately following the publication of this letter in the *Philosophical Transactions* was noted for the brilliant investigations of Nicholson and Carlisle, Berzellius and Hissinger, of Dr. William Henry and of Sir Humphrey Davy, which established a new epoch in the history of chemistry as well as in the science of electricity. This period, especially the latter part of it, is one of the most important in the historical development of the science of electricity, covering, as it does, the first two decades of the present century and closing at the time of the announcement, through *Thomson's Annals*, of Oersted's discovery which laid the foundation of the science of electromagnetism. The year 1820 is likewise noted as the time of Ampère's exposition of the phenomena of electrodynamics, as well as the important experiments in that line made by Arago and Davy, whose united work was afterward so assiduously and effectively followed by Michael Faraday. The present series of articles will be amply illustrated by portraits of the early philosophers and scientists whose work has proved to be the foundation of the modern science of electricity. Illustrations will also be given of the most important apparatus employed in the investigations of that period.

Cost of Electric Traction. THOSE of our readers who are interested in the subject of electric railway finances will find a short article in this issue which contains some very definite facts regarding the cost of operation on the West End Street Railway in Boston. This brief summary may well be taken as a supplement to the figures of a similar kind given in our issue of Aug. 20 concerning the operation of the West End road and those in in our issue of Aug. 27 giving the statistics of the last six months operation of the City & South London underground road. The comparisons shown in our columns this week are especially interesting, since some very definite information is given regarding the comparative cost of operation of street railways on a large scale by means of horses and electric motors respectively. The figures show that the West End Street Railway is now operating 1,000,000 electric car miles per month, an increase in two months of over 150,000 car miles. As might be expected, the result of this increased car mileage of the electric cars is a decrease in the cost not only of the maintenance and repairs, but also of the cost of motive power per car mile. The figures show that while the car mileage has increased, as stated above, about 15 per cent. the total cost of motive power has decreased by about $3,000. Another interesting point worth consideration is the fact that no additional employés have been needed for the operation of the increased car mileage. According to the monthly statement the cost of motive power for the month of July was 5.22 cents per car mile for the electric system, as compared with 11.36 cents per car mile for the lines operated by horses. It will be seen that in the latter case the cost per car mile is more than double what it is in the former. The total expense per car mile was for the electric cars 21.87 cents and for horses 26.14 cents. This economy of operation is certainly a matter which the managers of horse railroads cannot afford to overlook, and, indeed, there seems to be good evidence that almost every horse railroad now in operation, except, perhaps, those run on a very small scale, would be willing, provided the necessary municipal permission could be obtained, to change immediately from the horse to the electric system.

ELECTRICAL WORLD PORTRAITS—XXXIV.

Hermann von Helmholtz.

Our readers will have noticed from our report of the recent meeting of the British Association that one of the most prominent figures among the scientists gathered at Edinburgh was Prof. Helmholtz. Although now a venerable man, he had visited Scotland for the express purpose of being present at this meeting to take part in the discussion of the report of the Committee on Electrical Units, a subject in which he has taken the greatest interest for many years. For this reason a review of that part of his life work which pertains to electrical investigation will be of interest at the present time.

Hermann Ludwig Ferdinard von Helmholtz was born on Aug. 31, 1821, at Potsdam, where his father occupied the position of a teacher in the "gymnasium." The mother of Helmholtz was the daughter of a Hanoverian artillery officer of the name of Penne, a lineal descendant of William Penn, the renowned founder of Pennsylvania. In his seventeenth year Helmholtz entered the University of Berlin as a student. Helmholtz would have liked to have devoted himself to the study of physics. Circumstances, however, compelled him to enter on the study of medicine at the Frederick William Institute.

In the year 1847, in a small pamphlet on "The Conservation of Energy," he gave a vigorous proof of the following proposition: "In all cases of the motion of free material points under the influence of attracting and repelling forces whose intensity is solely dependent on the distance [the loss in potential energy is always equal to the gain in kinetic energy, and the gain in the former is equal to the loss of the latter, so that] the sum of the kinetic and potential energy is always constant." From this it follows that no energy is lost in the world, but that it alters only in its mode of manifestation, so that, for instance, chemical affinity can be converted into heat or electricity, this latter into heat or motion of masses, etc. At the same time, he showed that all the processes of Nature obey the laws of mechanics. Previously to this, heat had always been regarded as a "substance." Helmholtz showed "that the phenomena of heat can all be looked upon as motion."

But at first he met with opposition from authorities on the subject. His article was rejected by *Poggendorff's Annalen*, and among the members of the Berlin Academy only Jacobi, the mathematician, espoused his cause. Even when his fame penetrated through wide circles doubt was thrown on the originality of this epoch-making work. Helmholtz had written his pamphlet in ignorance of the work of Robert Mayer (1842 and 1845). When still in the third form of the gymnasium of Potsdam he had found it perplexing to reconcile the experiments of Rumford and Humphrey Davy on the production of heat by friction with the then orthodox conception that heat was an imponderable substance. What wonder, then, that as a fully developed mathematician and physicist he should recognize that the "heat resulting from friction is to be looked upon as the apparently lost *vis viva*?" Helmholtz readily acknowledged the priority of Joule and R. Mayer even before it was claimed, and was the first to bring into prominence the merits of the doctor of Heilbronn in the discovery of the great new universal principle.

Helmholtz calmly followed his own lofty path as teacher of anatomy in the Academy of Art in Berlin and assistant in the anatomical museum; he succeeded one of his friends occupied in the same pursuits, namely, Brücke, and found another, E. du Bois Reymond, still with his teacher, Johannes Müller. In the following year Helmholtz was called to Königsberg as professor of physiology and general pathology. Helmholtz was always an enemy of the deductive method. "The fact of a conclusion being drawn by the most accurate and logical methods from an uncertain premise does not add a hair's breadth to its certainty or value." Many old physiologists considered it beneath their dignity to make experiments, but Helmholtz always maintained, in contradiction to the metaphysicians, that "it is the duty of scientific research to seek the laws governing disconnected facts."

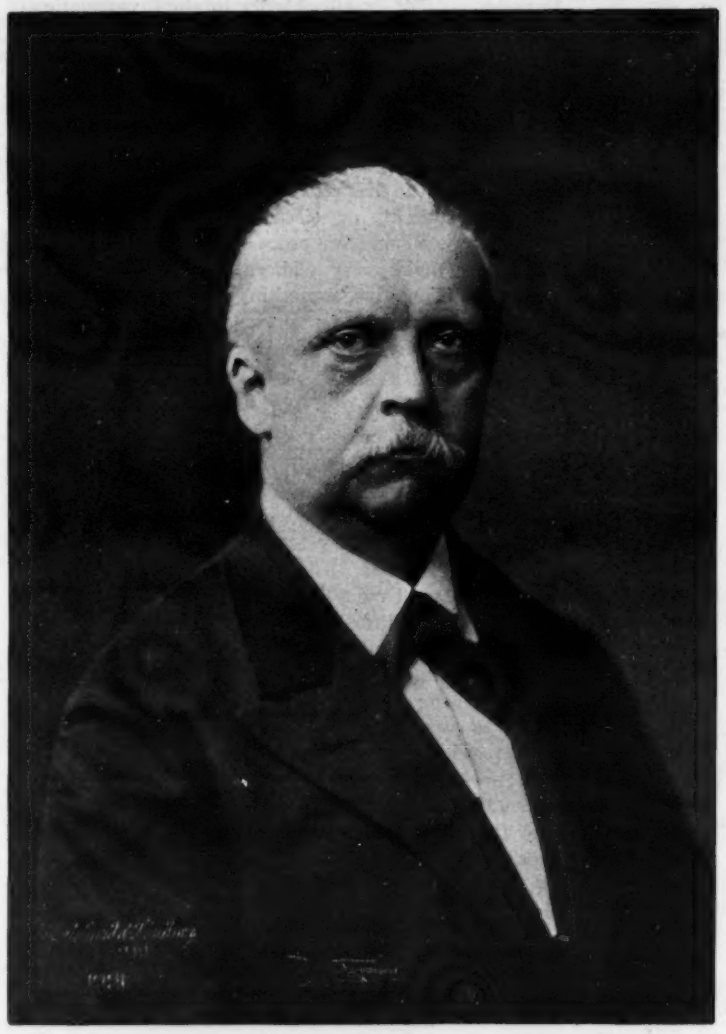
In the year 1851 Helmholtz astounded the scientific world by his discovery and description of the ophthalmoscope, for examining the retina in the living eye, "an optical instrument, by the aid of which it is possible to see exactly, and to recognize, in the living eye, the retina itself and the images of luminous objects thrown on it." By this discovery Helmholtz raised ophthalmic medicine to the position of a scientific study, and made it possible to save the eyesight of thousands of human beings.

It was by work of this kind that Helmholtz worked out and elaborated physiological optics. Afterward, when Professor of Anatomy and Physiology in Bonn (1855), he investigated the composition and action of the spectral colors. Ten laborious years he devoted, mostly, to his "Text Book of Physiological Optics" (1856-1866). In this work he made it "his duty to test and verify all essential points by his own observations and experiments."

The great men who at that time, together with Helmholtz, laid the foundation of the modern German physiological school, E. H. Weber, C. Ludwig, E. du Bois Reymond and Brücke, had obtained for this science an independent position. It had come to be recognized that physiology must be separated from anatomy, and Du Bois Reymond had avowedly claimed for it the proud aim of ultimately merging into physics and chemistry. The new Chair of Physiology in the University of Heidelberg was offered to Helmholtz and accepted by him. It was in Heidelberg that he produced his work entitled "The Doctrine of Tone Sensations as a Physiological Basis of the Theory of Music."

It was but natural that the intellectual tendencies of the exact investigator should predispose him to accept the Chair of Physics in the University of Berlin, which had just become vacant by the death of Magnus (1871). From this time forward he was engaged chiefly in inquiries in the great departments of electricity and hydrodynamics. The attempt had been made by celebrated physicists and mathematicians, like W. Weber, Riemann and Clausius "to explain electrodynamic phenomena by the assumption of forces acting at a distance between two portions of the hypothetical electrical fluid, the intensity being dependent not alone on the distance but also on the velocity and acceleration." The general mathematical formula of "the law of potential" for the strength of induced currents had been deduced from Ampère's law by the Nestor of Königsberg, F. E. Neumann.

At the time of its discovery, Newton put forth his great law of gravitation, which was to hold together the solar system, with hesitation and diffidence. The idea of forces acting in the absence of intermediate points of action, although then so daring, seems now self-evident. Faraday again raised the discussion on the problem whether forces



HERMANN VON HELMHOLTZ.

exist acting at a distance without an intervening medium, by his remarkable discoveries of the phenomena of induction, rotation of the plane of polarization by magnetization, and dielectric polarization of insulators and of diamagnetism. He concluded that every portion of space through which the magnetic force acts is in a permanently altered condition, in a state of tension which tends to return to its original condition as soon as the magnetic influence ceases, and that every alteration in this condition is manifested by the appearance of electromotive forces. Maxwell worked out the new theory mathematically and showed the possibility of regarding electricity, magnetism and light as merely different states and motions of the same medium (the ether).

The aim of Helmholtz in this direction "had been to determine in what direction experiments should be made to decide between the various theories. He succeeded in making such an experiment on the electricity collected on the surface of a conductor rotating in the magnetic field. This experiment decided in Faraday's favor." The second great problem whose elucidation Faraday had in mind, namely, the relation between electrical and chemical forces stimulated v. Helmholtz to a series of important investigation. He formulated Faraday's law in this way: "Through every cross section of an electrical conductor there is always equivalent electrical and chemical motion." He then investigated this motion and the forces expended on it. He was able by means of the mechanical theory of heat to calculate (in the case of a solution of salt the effect of the water on the electromotive force. In this way he came to the investigation of the thermo-dynamics of chemical process and solved the general problem—what portion of the energy present in any system can be transformed into another kind. He arrived at the result that all chemical compounds below their dissociative temperature give off heat, if produced in the reverse manner. In a highly ingenious manner he showed the reflex effects of the ether and ponderable atoms on each other, in his work work on "The Theory of Abnormal Dispersion."

Having in 1888 already shown the remarkable analogy of the vortex motions of water with the electromagnetic effects of electric currents, he now applied the theory of friction of solid bodies to that of flowing extremely thin films of fluids, and thus created an analogy between electrodynamics and hydro-dynamics (1879). He also introduced the conception of "Electrical Convection," viz., "The Transmission of Electricity by the Movement of its Ponderable Conductors" (1876). He showed that the law of constancy of energy makes it possible, without the aid of any hypothesis as to the internal constitution of electrically or magnetically polarized bodies, to find the effect of the forces acting on the interior of such bodies, and causing changes of form. The conclusion is that the hypothetical system, assumed by Faraday, of tensions acting along, and pressures at right angles to, the lines of force, actually exists and acts in such bodies.

Lightning is explained in one of his lectures somewhat as follows: The earth is permanently charged with (probably negative) electricity. Air and water vapor (not fog) are electrical non-conductors. Only when the clouds unite to form rain, and thus allow their water masses to come near enough together to allow of discharge from drop to drop, do they form one mighty conductor into which enormous sparks, lightning, can pass from the earth. The rain appears on the earth after the lightning, because it takes so much longer to fall than the time occupied by the electrical discharges. It is not at all impossible that a fire, or the thunder of the cannon in battle, should bring about a storm. If a state of unstable equilibrium already exists in the atmosphere, any circumstance which will cause the first small portion of the damp, warm mass of air to rise may act the part of a spark in a powder magazine, and direct the chief discharge to the spot of this primary disturbance. We cannot hope ever to be able to forecast the weather. For small primary errors do not produce simply small errors in the results, because the item of unstable equilibrium enters into the conditions.

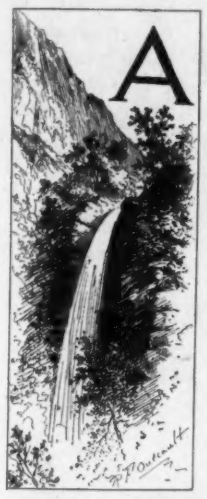
In the autumn of 1887 the German Empire founded a physical-technical institution, Dr. Werner Siemens, the well-known electrician, having given for the purpose a sum of one half million of marks (£25,000). Over this institution Helmholtz was chosen by the government to preside, while he was further appointed director of the first, or purely scientific, department. In consequence, he resigned the chair of physics and the directorship of the Physical Institute of Berlin, though he still retains the position of professor *ordinarius* in the university, and delivers lectures on special subjects of theoretical physics. In 1883 the German Emperor conferred on Helmholtz and on his family the honor of hereditary nobility.

What a noble revelation of his inner self does he afford us in the toast in honor of the town of Heidelberg, which he proposed on the occasion of the fifth centenary of the foundation of the University of Heidelberg. He would, he said, consider the beauty of the University town from the standpoint of the man of science: "Was it a mere accident that it was from these green hills that the mental eye of man for the first time penetrated the immeasurable world of space with the idea of how the chemical nature of the heavenly bodies might be deciphered—an undertaking which just before must have appeared an utter impossibility? I think the opposite. Something of a poet's intuition the investigator must have. Naturally, he must have care and patience to sift and prepare his material. But work alone cannot compel luminous ideas; these, like Minerva from the head of Jupiter, spring into being unexpected and unforeseen; we know not whence they come. This only is certain. To him who knows life only from books and paper, and who is tired and exhausted by the monotony of work, to him they come not. The consciousness of fullness of life and power must be present, such as comes from wandering in the pure air of the mountains. And when the wanderer, separated by the quiet peacefulness of the forest from the turmoil of the world, beholds at one glance, spread before him, the rich plain with the fields and villages and the setting sun spinning golden threads over the distant hills then arise in sympathy with the dark background of his mind the germs of new ideas destined to bring light and power into the inner world of his imagination, where before there was chaos and darkness."

Thus this great man in the festive hours allows us to catch a glimpse of the workings of the mind. But he who would appreciate the full stature of this ruling mind must climb the lower intellectual heights, and the greater the height he is able to attain the more gigantic will the mountain seem above him. To-day the scientific men of both hemispheres unite to do honor to Helmholtz.

A Long Distance Transmission Plant between Tivoli and Rome.

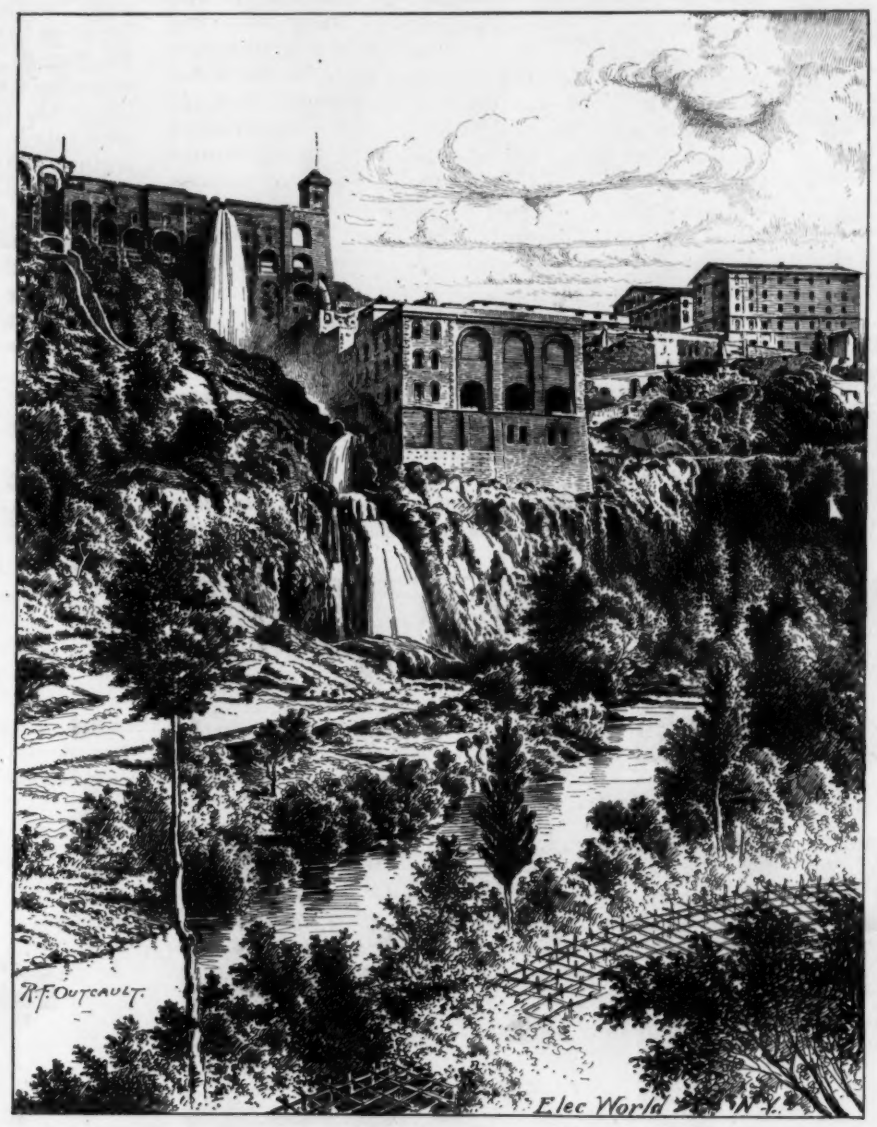
(From our Special Correspondent.)



AN interesting plant for the transmission of electricity for lighting and power is that recently opened at Tivoli, where the electric current, generated by water power, is used for arc and incandescent lighting in the city of Rome, some 17 miles distant. This plant was erected by the Roman Gas Company as a supplementary source of electricity to the central station at Rome. This company has been operating its station at Rome for six years, the source of power being steam engines having a total capacity of 2,700 h. p. This plant, together with the newstation now in operation at Tivoli, is expected to supply the city of Rome with electric lights for public and private use, and with electric power wherever it is demanded for industrial purposes.

Tivoli abounds in cataracts as beautiful as they are useful, which have served for centuries as a source of power for various industrial enterprises. In 1887 an electric plant was established at Tivoli which is still in operation, but this is only of small size. It was constructed by the firm of Gaulard & Gibbs for supplying Tivoli with electric lights, the system used being the alternate current with transformers in series. Some years ago a company was organized for the purpose of utilizing the water power of the falls at Tivoli for the generation of electricity to be transmitted to Rome, but for various reasons the project was never completed. In 1888 the director of the Roman Gas Works, Mr. C. Panchain, took the matter in hand, and to him belongs the credit for having carried the enterprise to its present successful completion. The old and incomplete plant was purchased and the construction of the new station undertaken. This station is erected on the site of the old villa Mecenate, where a water fall of 3¾ cubic metres per second, 110 metres in height, furnishes the necessary power. The water is carried through a canal on an old Roman viaduct to the wheel house. The canal terminates in a tower in which there is a stand pipe of sheet iron 125 feet high and 50 feet in diameter; from the bottom end of the stand pipe a sheet iron pipe of the same width projects 150 feet further on and carries water to the level of the ceiling of the wheel house. The station stands half way up the side of a mountain, as shown in one of our illustrations. The main room in which the dynamos and turbines are placed is 80 × 50 feet. The main pipe for conveying the water into the machine room is divided into three cross pipes from each of which three vertical pipes lead out These nine vertical pipes conduct the water to the nine turbines. A complete system of valves which can be regulated by hydraulic pressure from the machine room makes it possible to close each of the three cross pipes whenever necessary within a very few seconds. Corresponding with the three sets of pipes nine turbines form three groups, each group consisting of two 300 h. p. turbines and one 50 h. p. turbine. Each turbine is coupled direct to its corresponding dynamo. The turbines are of the Giraud type the 300 h. p. wheels having six inlets and valves, and the 50 h. p. wheel having one inlet and a throttle valve. The former are constructed for 170 and the latter for 370 revolutions per minute. Each turbine is provided with a self-acting regulator of the Ganz system, which by regulating the water supply keeps the speed as accurately constant as is the case with the best types of steam engines. The turbines are completely inclosed in protecting cases, the water outlet being subterranean. In our illustrations one of the wheels is shown with the protecting cover removed. Every precaution has been taken to keep the machine room dry.

Each of the larger turbines drives an alternating current machine, which, at 170 revolutions per minute, supplies a current of 42 ampères, at a potentialof 5,100 volts. The armature of each of these machines is 2.2 metres in diameter, and each generator has 30 poles. Each of the smaller turbines is coupled direct to a four-pole exciter, running at 375 revolutions per minute, and furnishing a current of 150 ampères at 180 volts electromotive force. Both the exciters and the large alternators are arranged in parallel. The exciters have hand rheostats. The regulation is effected by two automatic rheostats of the Bláthy type in the field circuit of the exciting machines. These are so arranged that the electromotive force of the alternating currents is kept constant at the distributing station in Rome. The breaking



EXTERIOR VIEW OF THE TIVOLI CENTRAL STATION.

of the circuit is effected by means of a dead resistance of iron wire.

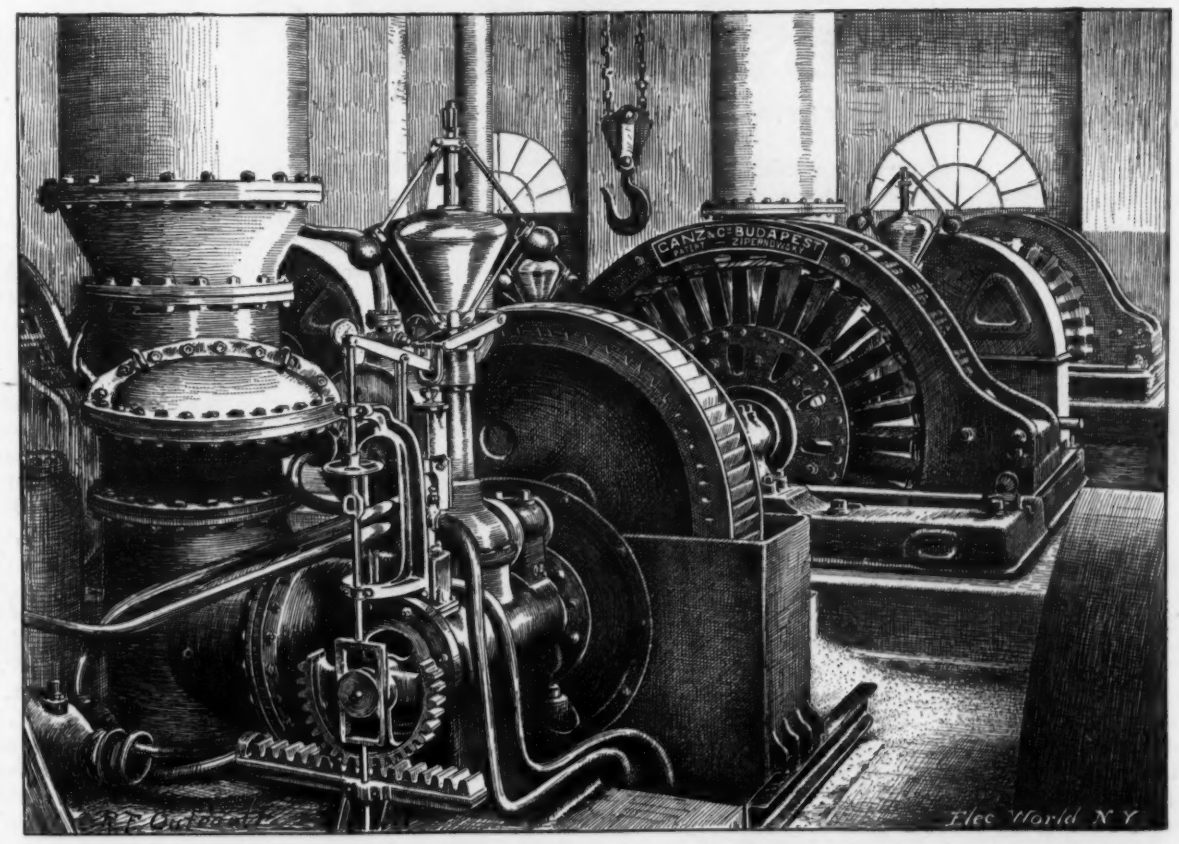
The conductors from Tivoli to Rome are carried through the deserted and forlorn Campagna Romana for a distance of nearly 17 miles. The leads consist of four copper cables of 19 wires each, the entire system of conductors containing 100 tons of copper. These cables are so arranged that they can be exchanged at will in case of accidents or when repairs are necessary. Of the existing four cables three are sufficient for running the entire plant, while two are sufficient for two thirds of the load. The loss in transmission amounts to 20 per cent. of the total pressure, that is 1,020 volts, the initial pressure being 5,100 volts. The cables are attached to very strong oil insulators placed upon poles, or iron columns set from 115 to 130 feet apart. These poles consist of two parallel T-irons connected together by bolts, at the upper end of which are wooden uprights 10 feet in length, to which the oil insulators are fastened. The same line of poles carries silicon bronze wires for telegraph and telephone purposes, the lowest wire being 25 feet above the ground.

The conductors from Tivoli terminate at the old Roman wall near the Porta Pia, in a small building, where the necessary transformers and other apparatus are placed. As the central station in Rome is operated at a pressure of 2,000 volts, and as the Tivoli plant, as stated above, is intended as a supplementary station for the plant in Rome, the current from the Tivoli station must necessarily be reduced from 4,000 to 2,000 volts. For this purpose 32 transformers, each of 25,000 watts capacity, are placed in the transformer building. Of these 32 tranformers, 16 arranged in parallel, form a group which transforms the 4,000 volt current into a current at 2,000 volts, and transfers the current from the Tivoli aerial conductors to the underground network of concentric cables that distribute it over the streets of Rome. In the summer, when the demand is at a minimum, and also during the daytime at other seasons of the year, it is intended to operate entirely from the Tivoli plant, and to make use of the Rome central station only when greater demand makes it necessary.

At present 250 arc lights are in use, but this number can be increased at any time to 600. These lights are in series of 45 each, and have aerial lines of copper wire four millimetres in diameter. The use of aerial lines was necessary, from the fact that the lamps are widely distributed over the city, quite a number being at a considerable distance from the underground network of cables.

Each of the large transformers in the transformer house is able to furnish 14 ampères at 2,000 volts for supplying 45 arc lamps; 14 such transformers are able to feed the 14 arc light circuits, or over 600 lamps, the other two transformers being kept in reserve. In each of these circuits an automatic rheostat keeps the intensity of the current constant at 14 ampères.

The entire outfit of the central station and of the transformer house as well as the arc lamps, was furnished by Ganz & Co., of Budapest. The conductors and their supports were furnished by the Society Anglo-Romana according to the specifications furnished under the direction of Ganz & Co The entire plant is modeled on the Zipernowsky-Deri-Bláthy system, and represents one of the most advanced types of European practice in the distribution of alternating currents over long distances for lighting and power purposes. It is interesting to know that this plant was planned as far back as 1888, a time when the application of a 5,000-volt current for any purpose was considered very remarkable.



INTERIOR VIEW OF THE TIVOLI CENTRAL STATION.

A People's Physical Laboratory.

BY FRED P. BERGH.

As there are a great many persons investigating the phenomena of electricity in all its branches, and as some of them have ideas that they cannot carry out without expensive instruments and tools with which to make new inventions and discoveries, I would like to suggest the idea that a physical laboratory be established by a stock company whose source of revenue might consist of a charge for the use of instruments and materials and a certain percentage of all sales of inventions and discoveries that may have been developed in the laboratory. Such a physical laboratory would give to the world ideas and discoveries that might otherwise be lost; and persons bringing their ideas or discoveries before competent and trust-worthy men would soon find out whether they were of commercial or scientific value, where instruments and machinery were so accessible.

The Trolley System in New York.

A very important franchise has been granted by the New York Board of Aldermen to the Union Railway Company, better known as the "Huckleberry" road, permitting it to operate numerous lines in the annexed district, under the trolley system. This company already has one trolley line completed and ready to put in operation, which was illustrated and described in The Electrical World, of Aug. 20, 1892. The franchise provides that the company shall pay nothing until the receipts amount to $1,700 a day. After that, one per cent. of the gross receipts must be paid to the city, and when the receipts amount to $1,700 a day more, an additional one per cent. is to be handed over by the company.

This is regarded as second in value only to the Broadway franchise. The provision that the road shall pay nothing to the city until its receipts average $1,700 a day will, it is thought, exempt it from expense for 10 years.

The following are the routes covered by this comprehensive francise:

Beginning at the Macomb's Dam Bridge on Jerome avenue, and extending through and along said avenue to the city line.

Beginning at Morris avenue, as it intersects with Third avenue, and extending north and along said Morris avenue to Fordham Landing (or High Bridge road).

Beginning at the Harlem River on Willis avenue, and extending north through and along said Willis avenue to its intersection with Melrose avenue; thence through and along said Melrose avenue to its intersection with Webster avenue; thence through and along said Webster avenue to its intersection with the Bronx River road; thence through and along said road to the city line.

Beginning at the city line at the Bronx River on Tremont avenue and extending west through and along said Tremont avenue to its intersection with Webster avenue and Burnside avenue; thence through and along said Burnside avenue to its intersection with Sedgwick avenue and Cedar avenue; thence through and along Cedar avenue to its intersection with Riverview Terrace; thence southerly and along said Riverview Terrace to its intersection with Sedgwick avenue, also west through and along Dock street from its intersection with Riverview Terrace to the tracks of the New York & Northern Railroad Company.

Beginning at the intersection of Olin avenue with Webster avenue, and extending east through and along said Olin avenue to the city line.

Beginning at Washington Bridge on Boscobel Avenue, and extending east through and along said avenue to its intersection with Jerome avenue.

Beginning at the terminus of the tracks of the Harlem Bridge, Morrisania and Fordham Railroad Company, at Fordham, extending west, over and across the bridge of the New York & Harlem Railroad to Kingsbridge road thence through and along said road to its intersection with High Bridge road; thence through and along said High Bridge road to its intersection with Sedgwick avenue; thence northerly along said avenue to its intersection with Bailey avenue; thence along Bailey avenue to its intersection with Broadway at Kingsbridge.

Beginning on Sedgwick avenue at its intersection with Jerome avenue and extending in a northerly direction through and along said avenue to the city line. Together with the necessary connections, switches, turn-outs, turntables, and suitable stands for the convenient working of said road, its extensions and branches.

An Electric Winch.

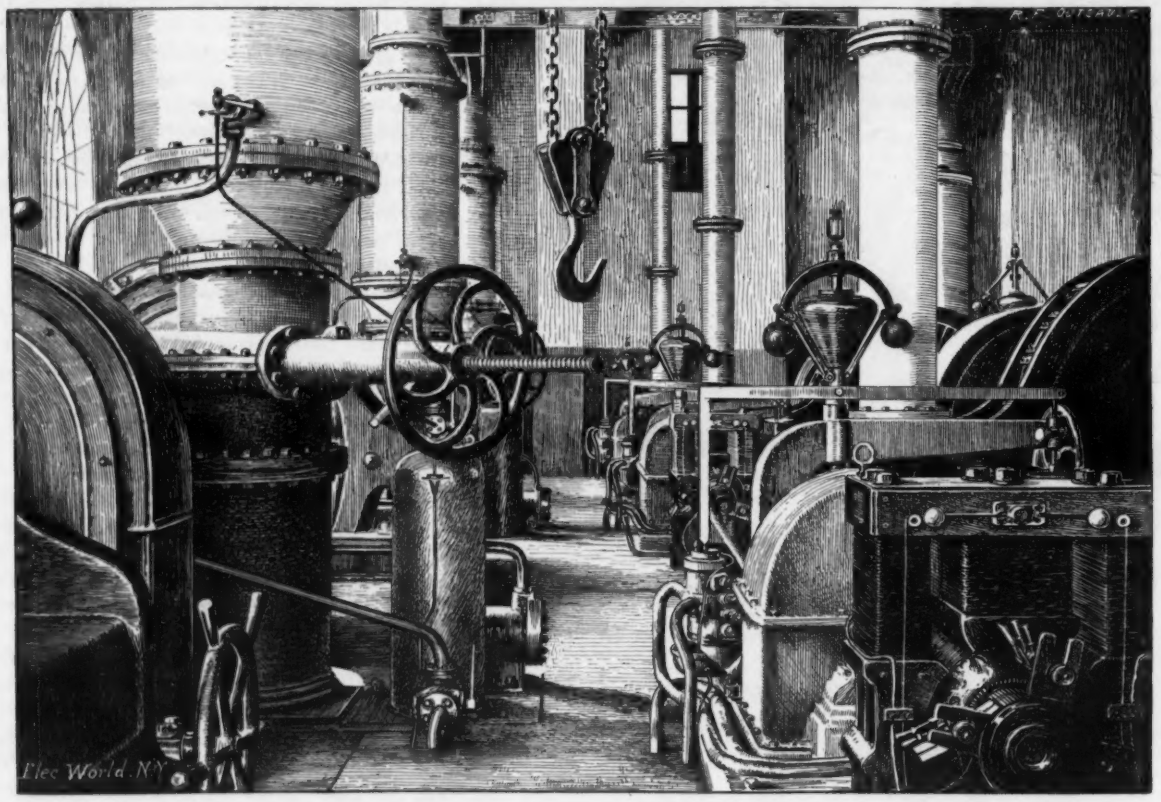
We give herewith an illustration of a handy little electric winch which is now being put upon the market by Messrs. Woodhouse & Rawson United (Limited), of London, Eng., and which, though specially designed for vessels fitted with an electric lighting plant, might be adapted to serve other useful purposes. It is claimed that this winch possesses every qualification of a steam winch, with far greater economy in working and the additional advantage of handling variable loads at equable speeds. The winch contains no complicated gearing, and may be managed by one attendant by means of the two hand-wheels or levers, by a simple movement of which the speed of lifting or lowering can be varied to any extent or the loads instantaneously suspended. An important feature of this apparatus is that a load can be lowered if desired at a variable speed, and this is done with the motor running at one constant speed, the load being lifted, lowered, or held by a simple turn of the wheel. The bearings and base are of large proportions, and a covering is supplied by which the motor and gear wheel are entirely incased. The motor is of special construction, being designed so as to be unaffected by the weather or water.

Electricity at the World's Fair.

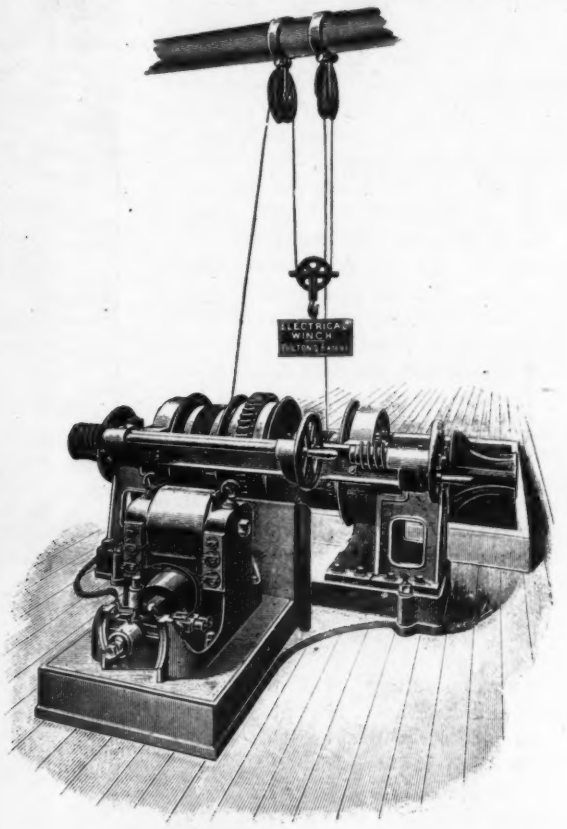
(From our Own Correspondent.)

When the electricians of the world congregate in Chicago they will rejoice in the universal application of electricity that will be found on every hand. Not only will launches large and small be sent swiftly shooting through canal and lagoon by electric power, not only will all vehicular transportation on the roadways be electrically propelled, whether carriage or cab, phaeton, tricycle or bicycle; not only will the lighting effects be on a grander scale than ever before attempted and in harmony with all that is artistic and beautiful, but if the visitor enters the Horticultural Building he will find most of the machinery driven by electric motors, from the smaller garden appliances to the big cider press. If he strolls into the Fisheries Building he will find colored bulbs in the great tanks of salt water that is kept in circulation by special pumps driven by electric motors; and in the big basins the fresh water fish will also be dependent on electricity for currents of cold water. In the oil tanks supplying the fuel to the banks of boilers electrically driven pumps will maintain a constant pressure at the point of delivery 3,000 feet away, and the use of incandescent lighting will do away with all possibility of explosion on the darkest night. The visitor will seldom come across line shafting, but everywhere will either see direct connected electric motors or the utilization of a bit of jack shafting where several light machines are supplied with power by one motor. In the Mines and Mining Building, where the process of mining will be shown in various stages, electric drills and coal cutters and mining locomotives will further illustrate the universal application of electricity. Especially will this feature stand out prominently in the great Machinery Hall, where the electric motor expected in the beginning to have no footing. To-day the applications for electric current to drive machinery far exceeds the present capacity, and the question naturally arises: Are the manufacturers of motors preparing to meet the orders for motors of from one to 20 h. p. that will surely be sent in by the respective exhibitors from every section of the country. The exhibitor must supply the motor that he will require, the exhibition officials only leading the circuit wires up to the motor and furnishing the current. If 100 electric motors are going into the Horticultural Building, almost the last place to look for one, the question is: How many will be required in Machinery Hall? Then there is the Transportation Building and the Agricultural Building, where hundreds of farming machines will be kept in motion to bring out their important features; and the Mining Building, too, where many motors will be required, even though the drills, the cutters and the locomotives are all self-contained. Not less than a thousand small motors will be employed in transporting visitors about the grounds, while the number may increase threefold; and 500 electric fans will certainly be required, the greater number of which will be wound for the alternating current. The manufacturers of electrical machinery could gain some valuable information by calling on Mr. Frederick Sargent and talking this matter over, although Mr. Sargent is a very busy man. Association with so enthusiastic a man as Mr. Sargent cannot help but prove beneficial. Sleeping on the ground, going to his home but once a week, leaving all thought of personal business to his partner, and concentrating his entire energies to the utilization of electrical energy in every form and in every place imaginable, he is doing a giant's work in broadening the electrical industry that can only be appreciated when the gates are thrown open, or, better still, by now wading through the plans, the blue prints and tracings of the various installations, and becoming as thoroughly aroused on the subject as Mr. Sargent is. Something in Chicago's atmosphere makes enthusiasm infectious.

Allotment of Space.—The amount of space applied for in the various departments aggregates more than 7,000,000 square feet, while the space to be allotted is far less than one-half that amount. In round numbers the applications in the several departments foot up about as follows: Agriculture, 618,000 square feet; Viticulture, 382,000; Mines, 608,000; Machinery, 975,000; Transportation, 890,000; Manufactures, 1,775,000; Electricity, 366,000; Fine Arts. 281,000; Liberal Arts, 704,000; Ethnology, 64,000. Forestry, Live Stock and Fisheries are not reported. In the Electricity Building there is but 187,000 square feet at Chief Barrett's disposal, and a feeling of disappointment, on the part of the exhibitors, will naturally result when the final allotment is made public. Of the applications for space in the Electricity department, 68,700 square feet are from foreign countries, and a general idea of the portion of the building allotted to other countries can be secured from the plans shown on page 148. On the ground floor France has been allotted section Q, containing about 6,300 square feet; section K, 4,873 square feet, and a portion of section J, containing 5,458 square feet, making a total of about 16,631 square feet. To Germany has been allotted sections D on the ground floor, comprising 13,384 square feet, and a portion of section X, in the gallery, containing 5,998 square feet, making a total of 19,382. To England, together with Canada and Australia, portions of sections O and P, on the ground floor, have been allotted, and 5,598 square feet in section Y, in the gallery. Denmark and Holland will occupy admirable space along the east side to the right of the main entrance, while Italy, Spain and Russia will occupy the centre space in section P. Not one of the chiefs of department has half the space asked for by exhibitors, although important additions have been made to many of the buildings. So the chiefs, acting in harmony with a general plan agreed upon in conference with Director-General Davis, will make their final apportionment come within the limit of room at their disposal, giving the most liberal allowance to the most artistic exhibits, and rejecting everything that falls below a fixed standard. The Director General's instructions to his chiefs are: "Make your standard so high that it will be an honor to the exhibitor if his display is admitted at all." Thus, Chief Bar-



INTERIOR VIEW OF THE TIVOLI CENTRAL STATION.



AN ENGLISH ELECTRIC HOIST.

rett believes that if for instance the General Electric Company is willing to incur the heavy expenditures necessary in fitting up sections C, N and I, and the end space in sections J and H, in accordance with the elaborate plans they have outlined, no doubt all that space will be placed at their disposal. The electrical journals will be together on the ground floor along the east wall in section L. The phonograph display will be at the north end of the gallery in section S, adjoining the headquarters of Chief Barrett. Testing instruments will be placed in sections W, V and R, where a good, stable foundation will provide against the annoyance of excessive vibration. Insulated wire manufacturers will probably be in section T. In applying for ample space and limiting their exhibits to the highest class of their products, American manufacturers are showing their faith in the truth of the widely heralded statement that a display at the Exposition may prove to be an advertisement of incalculable value, far reaching in results and lasting in effect. For though the majority of factories are running on full time, and in many cases on overtime, and though a general prosperity abounds, yet from every corner of the globe messages are coming that tell of deferred purchases of machinery of all classes "till after the displays at the World's Fair are examined."

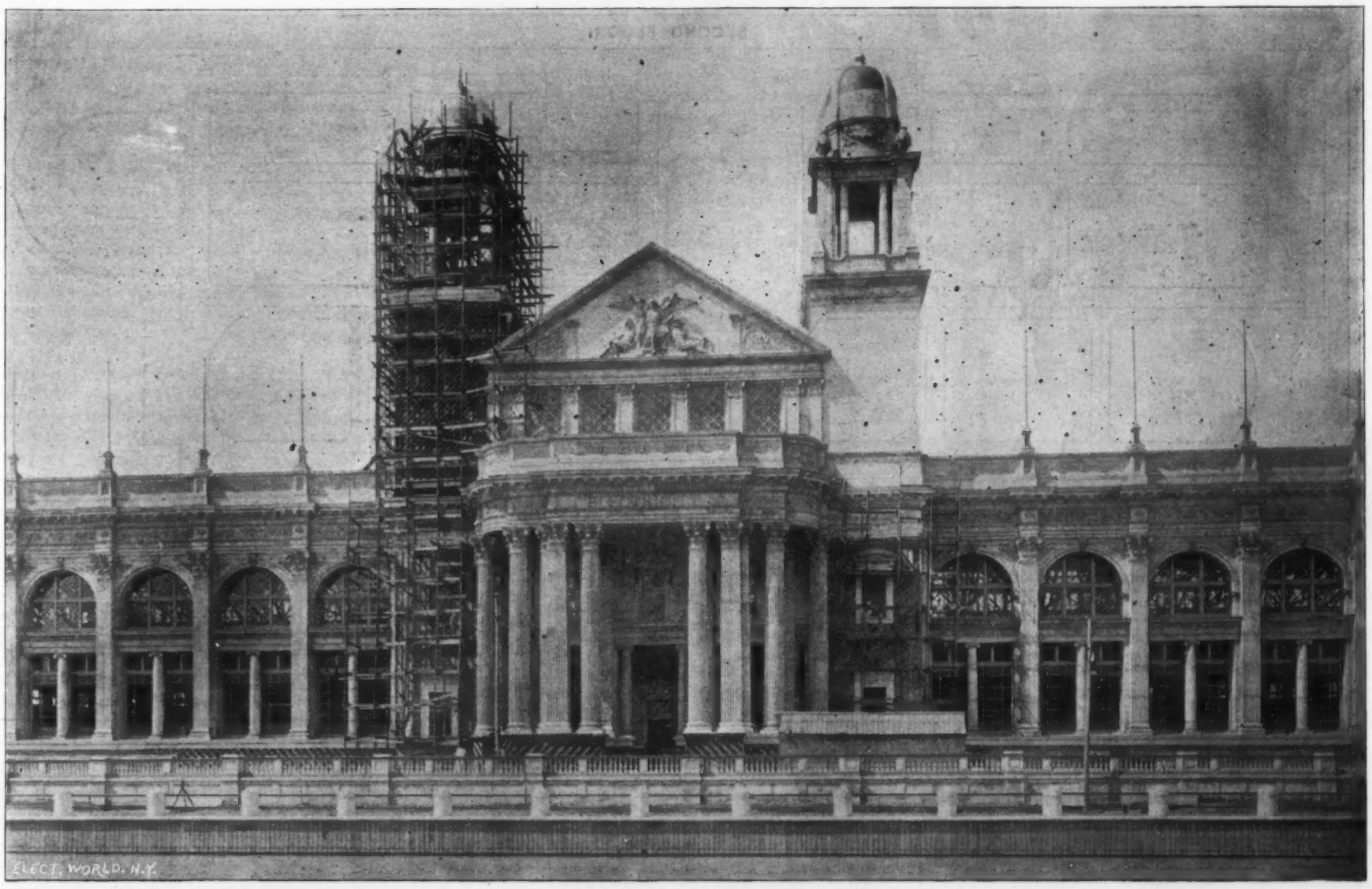
Machinery Hall.—The locating of the electrical power plant is about completed and will probably be approved at once. As now outlined, these plans provide a space 1,000 × 100 feet for the engines and dynamos, a space 800 × 80 feet for the boilers, and space for four immense pumping engines of seven and one-half, ten, twelve and fifteen million gallons per day capacity. That portion of Machinery Hall allotted to power installations has been divided into sections, in the first of which will be placed the Worthington circulating pumps; in the second section 250 h. p. Phœnix engines will drive four 250 kilowatt Eddy generators, while to two 500 h. p. Reynolds engines will be coupled two Westinghouse generators. In the third section will be one 550 h. p., and one 350 h. p. Woodbury engine belted to Mather dynamos, two of which are of 225 kilowatts and two of 120 kilowatts. In the fourth section four 150 h. p., and one 200 h. p. Ball & Wood engines will be belted to sixteen 50 light Brush arc machines. In the centre section one 1,000 h. p. Fraser & Chalmers engine will drive one 100,000 light Westinghouse dynamo, and a 2,000 h. p. Reynolds engine will be connected to two 100,000 light Westinghouse dynamos, while three large Westinghouse direct connected generators and engines will occupy a portion of this section. In the sixth section four 10,000 light Westinghouse alternating current dynamos will be directly connected to Westinghouse engines. In the seventh section three 10,000 Westinghouse alternating current dynamos will be belted respectively to a 1,000 h. p. Buckeye engine, 1,000 h. p. Atlas and a 1,000 h. p. McIntosh & Seymour engine. In the eighth section fourteen 150 light Fort Wayne Wood arc dynamos will be belted to Buckeye engines, two of which will be 100 h. p., one of 150 h. p., one of 200 h. p. and one of 300 h. p. The ninth section will contain twenty 50 light Standard dynamos, manufactured by the Standard Electric Company, of Chicago, belted to one 600 h. p. Russell engine, one 150 h. p. Russell engine, and to an engine not yet designated. The tenth section will be occupied by the apparatus for

ONE OF THE PROPOSED ELECTRIC TRICYLES FOR THE WORLD'S FAIR GROUNDS.

supplying compressed air. In the rear of, and separated from these sections, and under a separate cover, the boilers that will be used for supplying steam will be located in the following order, corresponding with the sections above enumerated: Abendroth & Root, Gill, Heine, National, Campbell & Zell, and Babcock & Wilcox.

The floor space of the boiler-house has been extended to make room for the boilers from Belgium, France and England that are now en route to this country, and this increase in steam capacity will enable Mr. Sargent to utilize several hundred horse power more in engines. Thus the first applicant who desires to place a high speed engine on exhibit within the power house will find an excellent location ready to support the engine bed. More especially desired is 300 h. p. divided preferably in two engines of 150 h. p. each, or one of 100 h. p. and one of 200-h. p., to be used in driving Excelsior arc lighting apparatus that will be connected in on both day and night circuits, the smaller engine carrying the day load. Two 400-h. p. engines are also desired for driving two 4,000 light Westinghouse alternating dynamos and two 500 h. p. engines to drive four No. 60 Edison generators that will be used in charging storage batteries and supplying current for illuminating the two electric fountains and the beautiful masterpiece of Mac Monnies. Arrangements have been perfected for securing two Ide engines that will be belted to four Eddy generators, each of 80 kilowatts, and two Skinner engines of 200 h. p. that will be belted to Westinghouse arc lighting dynamos. Then a 350-h. p. Skinner engine will drive line shafting, as will also a Bates-Corliss engine of 300 h. p. Next month 8,000 h. p. in engines will be under cover of Machinery Hall, unless present arrangements fail in materializing. When the strike at Homestead occurred, all but four trusses were secured, and to obtain the last four application was made to many manufacturers; none of them would guarantee to deliver for less than 25 cents a pound. So the iron material was secured by the construction department, and sheared and sharpened and punched on the ground, and to-day the department is independent of the Homestead strikes.

The Buildings.—A view of the east entrance to the Electricity Building, as it appeared on Aug. 21, is shown herewith. The main entrance is not yet completed, but the exterior of the remainder of the building is only awaiting the touch of the decorator, whose plans are well under way, while the sculptor's work is being pushed rapidly forward. Mr. C. Y. Turner, President of the Salmagundi Club, of New York City, is at the grounds assisting Mr. F. D. Millett, as is also Mr. Kenyon Cox, who returned this week from his wedding tour. Of D. H. Burnham, the *Inland Architect* thus speaks editorially: "The Chief of Construction sleeps at the grounds at least five nights in the week. He sees his superintendents by seven o'clock in the morning, and it is near midnight before the last business of the day is finished. Every one knows what his private practice is, and can estimate how much time he can give to looking after his personal interests. He is giving services to the country and the world such as no architect has ever done before, and in his firm, persevering, yet unassuming way, is making a name not for himself alone, but for the profession, which will place American architects in the front rank of those of the world and make their achievements the wonder of the century." The Westinghouse company will shortly commence to wire the Casino, the building designed with public comfort and waiting rooms on the ground floor, with private dining rooms on the third floor, reached by elevators, and with the greatest known public café and restaurant on the second floor, which affords a seating capacity for some 5,000 patrons. Of Grecian architecture, 250 × 140 feet, it forms the southern L of the peristyle and is located at the beginning of the long 2,500 foot pier, at which all lake passengers will disembark. In wiring the New York building the lamps will be so placed as to prominently bring out the architectural features, to make the entrance as distinct as possible, and to secure high artistic effects. This building is located in the northern section of the grounds facing the Art Galler-



EAST ENTRANCE TO THE ELECTRICITY BUILDING AS IT APPEARED AUG. 21.

ies. Including porticos, it is 214 feet long, and from 89 to 142 feet in width, and with the attractive roof garden affording a clear outlook over Lake Michigan will be a headquarters and club house worthy of the Empire State. One of the main features in the building, which is in the style of the Italian Renaissance, is the banquet hall, 84 feet long, 46 feet wide, and 45 feet in height, which will be lighted by incandescents arranged in clusters and in panels. Adjoining this banquet room is the dainty Marie Antoinette tea room for the ladies. The Horticultural Building, as well as the Art Gallery, will be a permanent fixture in Jackson Park, and the utmost attention is being given to the lighting features. The interior of the Horticultural Building will present a most attractive and interesting appearance from the outside, owing to the great surface of glass through which the rays from the arc lamps will be cast in every direction. Already several thousand potted plants are in the court or within the building, a number of which are valuable tropical plants. The Westinghouse Company are at work wiring the Art Gallery, all work being concealed. The converters are placed in the basement, under the loggia, in special brick vaults, as the entire installation is a permanent one. Two circuits are carried throughout the entire building, and the lamps placed alternately thereon; thus a fair amount of light is insured should either circuit be temporarily disabled. In the loggia the lamps will be placed in clusters of three in each panel. In the picture galleries, on the first floor, the lamps will be suspended from screens, the galleries in the four sections of the building each containing respectively, No. 1, 160; No. 2, 372; No. 3, 114; No. 4, 172; No. 5, 180; No. 6, 180; No. 7, 180; No. 8, 180; No. 9, 96 lamps. In both the north and south courts a 70-light cluster will be placed, and in the east and west courts two clusters of 70 lights each. Then there will be 26 chandeliers of five lights, each running north and south, and 34 five-light chandeliers to the east and west. In the upper galleries and the open courts the lamps will be placed 16 inches apart, in rosettes and cornices.

Shipping Rules.—The Traffic Department has issued a new circular covering the latest rules and regulations affecting the shipment of foreign exhibits, from which the following are extracted:

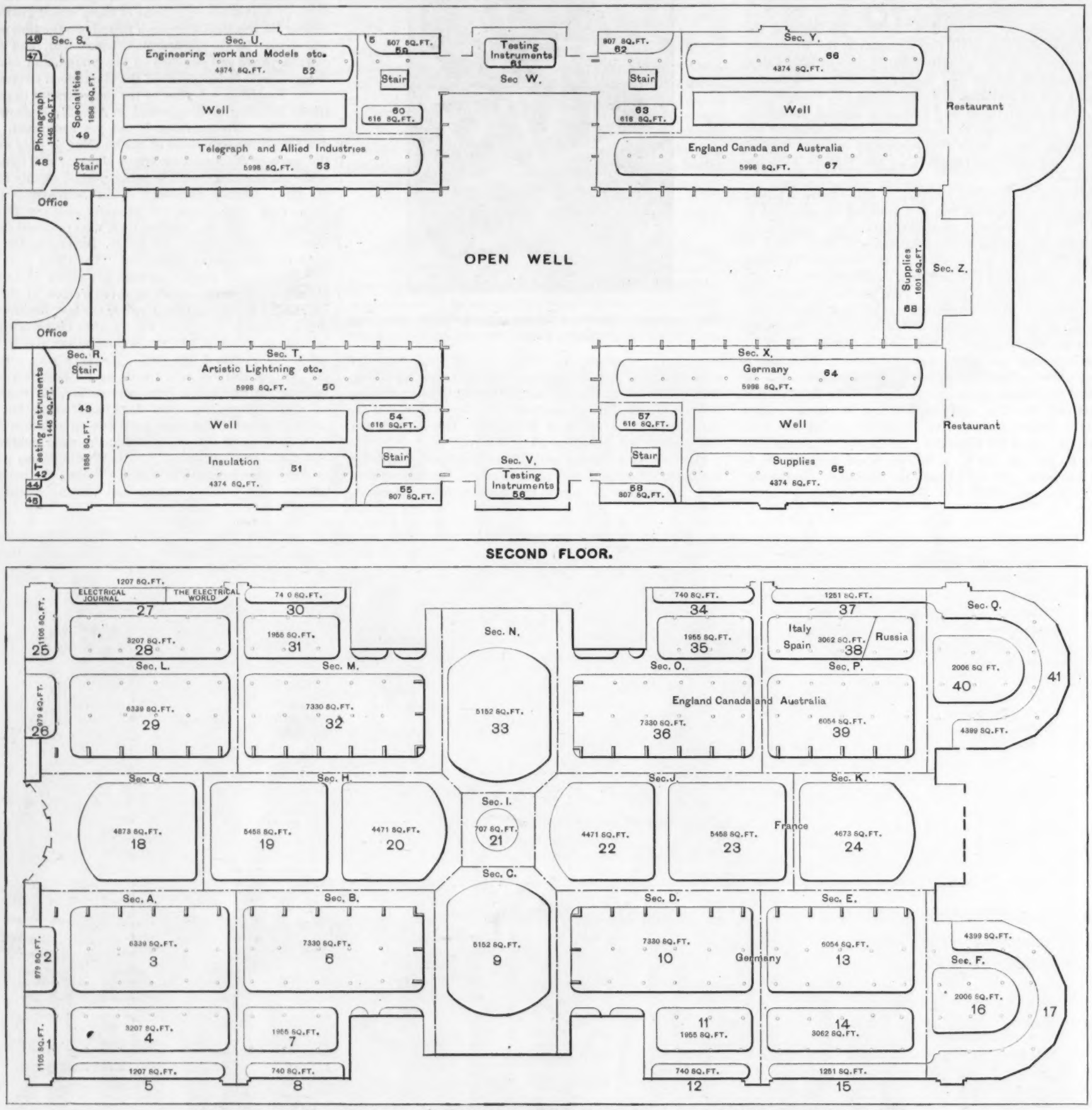
Foreign exhibits consigned in bond must be marked to the Collector of Customs, Chicago, U. S. A., and conspicuously marked "Exhibits for Columbian Exposition." Freight charges on exhibits, including the terminal charge, must be prepaid at point of foreign origin or at the American port of first arrival. The goods must be delivered at the Exposition clear of all charges incident to their transportation, as no transportation or other charges will be advanced by the Exposition management. Two copies of each bill of lading must be sent by the shipper to the Director General, World's Columbian Exposition, Chicago. Letters of advice should also be forwarded, giving information of the shipments made and full particulars in regard to articles of extraordinary dimensions or excessive weight. In the event that the consignees have not completed arrangements for exhibition, or are not prepared to receive them at the Exposition buildings at the time of the arrival of the shipments in Chicago, they will be delivered by the express company to the custodian of the bonded warehouse on the Exposition grounds, and when ordered taken from the bonded warehouse thereafter, an additional charge of 25 cents per 100 lbs., with a minimum charge of 25 cents per package, will be made by the express company for final delivery at the exhibit building. If no authorized person is at hand to take charge of the goods within a reasonable time after their arrival at the Exposition, they will be removed and stored at the cost and risk of whomsoever it may concern. The Director General will decide what goods shall be accepted as exhibits; and foreign articles not so accepted will be treated as dutiable merchandise and stored in warehouse within the Exposition grounds, and may be withdrawn upon payment of duties and charges at any time. The transportation, receiving, unpacking and arranging of exhibits for exhibition will be at the expense of the exhibitor. The installation of heavy articles, requiring special foundations or adjustment, should by special arrangement begin as soon as the progress of the work upon the buildings will permit. The general reception of articles at the Exposition buildings will commence on November 1, 1892, and no article will be admitted after April 10, 1893. Ample facilities will be provided for the storage of empty cases and packing material at the cost of the exhibitor, which cost will be made as low as possible, but must be paid before cases are taken in charge. Should any merchandise be abandoned by the owner at the close of the Exhibition, it will be placed in a general order warehouse for 12 months, and, if then unclaimed, will be sold for account of the owner.

In General.—A practical telephone exhibit will be the handsome line of 60 foot poles of the Chicago Telephone Company extending to the north and south along the west side of the World's Fair grounds. Each pole carries 50 hard-drawn copper wires over which the messages of visitors will pass to Eastern homes. Through the courtesy and under the guidance of Gen. A. H. Barney, manager of the Electric Launch and Navigation Company, many of the electrical fraternity of Chicago have this week enjoyed the rare pleasure of a ride on the lagoons and out on Lake Michigan in the handsome electric launch, the Volta, and many have been the appreciative words of praise given in behalf of the perfect service afforded.

Pennsylvania Building will have over 600 lights, many of which will be employed in decorative designs, while panel lighting will prevail on the ground floor and cluster and electroliers above. Wisconsin will have 240 incandescent bulbs in her State Building, mainly placed in the heavy oak-paneled ceiling. The council of administration has elected President H. N. Higinbotham of the local board of directors permanent chairman of the council, and A. W. Sawyer, assistant secretary, at a salary of $1,600. Chief Barrett, of the Department of Electricity, has sent out a circular letter to all the exhibitors in his department asking each to state the full amount of light and power required in their respective exhibits, and to what extent they will join in making attractive displays of incandescent lighting.

F. DE L.

CHICAGO, Aug. 27, 1892.



SECOND FLOOR.

PLAN OF THE ELECTRICITY BUILDING SHOWING ALLOTMENT OF SPACE.—GROUND FLOOR.

(All space not marked will contain heavy apparatus for lighting or power or both.)

Cost of Operating Electric Cars on the West End Street Railway.

The West End Street Railway of Boston is now operating 1,000,000 electric car miles per month. In June the revenue electric car mileage was 846,987, in July it was 971,862, and for August it is understood that it will exceed 1,000,000 miles.

The result of this larger electrical mileage is seen in a decreased cost of electrical maintenance and motive power per car mile. In July it was 4.56 cents against 5.06 cents in June. The total cost of electrical motive power and maintenance in July was $30,320 against $37,956 in June, and yet the car mileage was 124,875 miles, or 14 per cent. greater. In August, with 1,000,000 miles run, there is no increase in the number of employés.

The statement for the month of July is as follows:

JULY STATEMENT.

	Total.	Electric.	Horse.
Gross receipts	$603,415	$383,149	$220,266
General expenses	27,246	16,666	10,579
Track and car expenses	168,716	105,602	63,113
Motive power	120,811	50,777	70,033
Total operating expenses	373,838	212,589	161,248
Net earnings	229,577	170,559	59,017
Miles run	1,588,663	971,862	616,801
Ratio mileage	100	61.17	38.83
Per cent. of expenses	61.95	55.48	73.20
Earnings per mile run	37.98c.	39.42c.	35.71c.
Expense per mile run:			
Motive power	07.61	05.22	11.36
O her expenses	15.92	16.65	14.78
Total expenses	23.63	21.87	26.14
Net earnings per mile run	14.45	17.55	9.57

The following table shows gross and net earnings by months for May, June and July compared with last year:

Gross Earnings:	1892.	1891.	Inc.	Dec.
May	$540,846	$521,086	$19,760	.....
June	600,450	551,592	48,858	.....
July	603,415	555,739	47,673	.....
Total	1,744,711	1,628 417	116.294	.....
Expenses:				
May	$339,306	$364,210	.....	$24,904
June	368.416	353 135	$15,281	.....
July	373,838	366,317	7,521	.....
Total	$1,081,560	$1,083,663	.....	$2,102
Net Earnings:				
May	$201,539	$156,875	$44.664	.....
June	232,033	198,456	33.577	.....
July	229.577	189,422	40,155	.....
Total	$663,151	$544,754	$118,396	.....

The Three-Phase Motor in Europe.

BY OSCAR VON MILLER.

In reply to your inquiry regarding three-phase alternating current motor, I beg to say that the rotary current motors used at Heilbronn have been supplied partly by the Oerlikon machine works and partly by Allgemeine Electricitäts-Gesellschaft, Berlin, and have so far given entire satisfaction.

The main objection to the rotary current system is the difficulty of splitting the current consumed into three equal parts, or, if uneven distribution takes place, of regulating accordingly the tension in all three branches of the conductor. Besides this the use of three cables necessitates higher expense for insulation and transmission than two cables, so that the ordinary alternating current system, if high pressures are applied, deserves preference as soon as this system can be applied as easily as the rotary current system.

Experiments have recently been made in Europe in this direction by Helios, Ganz & Co. and Brown, Boveri & Co., which promises to be successful, so that I have been induced to use an ordinary alternating current motor for a central station in Fürsteufeldbruck, where electricity is generated by water power, 7 kilometres distant from the station.

MUNICH, Aug. 4, 1892.

Patent Law Amendments.

BY GEORGE HENRY KNIGHT.

The postponement to the next Congressional session of Senate bill No. 3,246 affords opportunity for American inventors everywhere to examine its provisions, and, if dissatisfied with either of its eleven sections, to interrogate their respective Senators and Representatives on behalf of such modifications as they may think desirable. Section 1, especially, seems worthy of their attention. Its ostensible purpose is the amendment of clause 2 of section 4,887, R. S., by which, as is well known, the duration of a United States patent is made dependent upon that of the earliest expiring, previously granted, foreign patent for the same invention; but the amendment would seem to leave the most obnoxious feature of the clause substantially unchanged. Especially vexatious has the clause proved to the creators of those notable devices, which, by inaugurating new arts and opening up hitherto untrodden fields of industry, constitute to some minds the chief justification of the patent system. If, as commonly supposed, our legislators aimed, by the clause spoken of, to confer on their constituencies some kind of advantage over the foreigner, that aim has signally failed; the recoil of the weapon has proved far more disastrous than the discharge! Of patent-granting countries ours is now admittedly foremost, alike in the liberality of its patent law and in the number and character of its useful inventions. The sum total of "aliens" prevented from exacting royalties on this side of the ocean is a mere bagatelle to the host of American inventors deprived, by this ill-advised clause, of the revenue of many millions that would have been drawn from the foreign user and circulated here; for it is notorious that a large majority of our inventors, rather than jeopardize their home patents, elect to forego the dangerous foreign privilege, with the result that American inventions are generally free to all except Americans. The writer believes that the effect of the clause has been only evil and that the only proper amendment is to expunge it, or if that may not be, then let American ingenuity at least be relieved from the unmerited and impolitic burden.

The Colgate Secondary Battery.

So much is expected of the storage battery and so anxiously is the time looked forward to when its application to commercial purposes may be entirely practical and economical, that any new battery or modification of forms which already exist finds a ready reception by the public. The battery, which is illustrated herewith and which is the invention of Mr. Arthur E. Colgate, of New York City, while not being a radical departure from the existing types, presents many new features of importance.

It is a modification of what is commonly known as the Planté type. Its construction can be very plainly seen from the accompanying illustrations. First, long, narrow and thin strips or ribbons of lead are formed and then

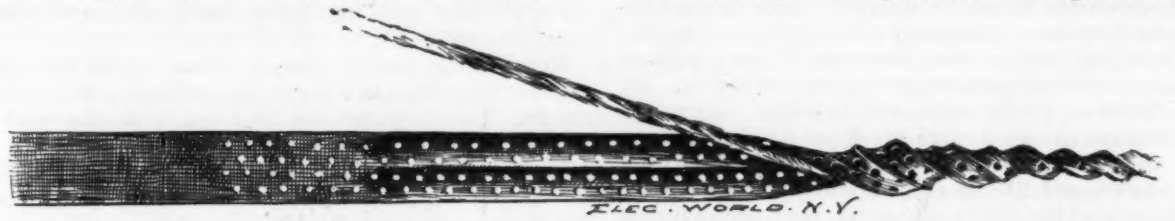


FIG. 1.—COLGATE SECONDARY BATTERY PLATE.

these are passed through a machine which perforates them, forms two longitudinal corrugations in them, and then twists them together with a cord or rope of asbestos into the form shown in Fig. 1. These strands are next woven into a loose mat, such as is seen in Fig. 2. Several of these mats are then put together under moderate pressure so as to form one plate, which is then inserted in a lead frame and is ready for use in the battery.

It will be seen that a plate of this type presents an extraordinarily large surface to the action of the electrolyte. This, indeed, is the feature of the battery. As a result of this, of course, the weight of the battery is very much reduced. The cell from which these details are taken is composed of four plates with a total weight of eight pounds. Each one of these plates is composed of three mats 6 by 8 inches pressed together. The plates are three-eighths of an inch in thickness, and are separated by a space of about three-sixteenths of an inch. The surface exposed is very great, there being 72 square inches of surface to each inch of floor space occupied by the cell. A discharge rate of one ampère hour per square inch of cell is claimed. The electromotive force is approximately two volts and the discharge rate 27 ampères.

In addition to the very light weight an unusually long life is claimed for the cell. From the formation of the plates it is practically impossible to destroy them by mechanical injury and the disastrous effects of buckling and short circuiting are claimed to be entirely avoided. This cell is consequently much better adapted to rough usage than the ordinary form of lead battery. Practical tests have proved to be very satisfactory, and the development of this new form of secondary battery will be looked forward to with interest.

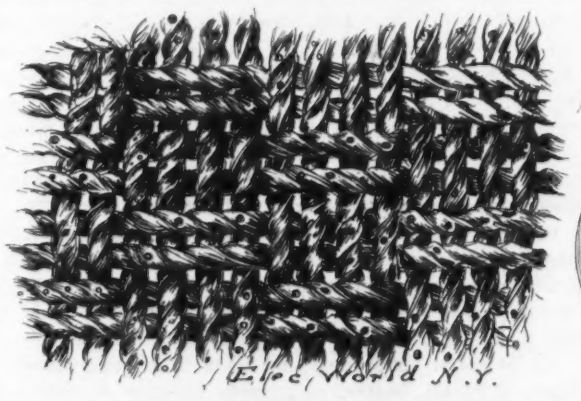


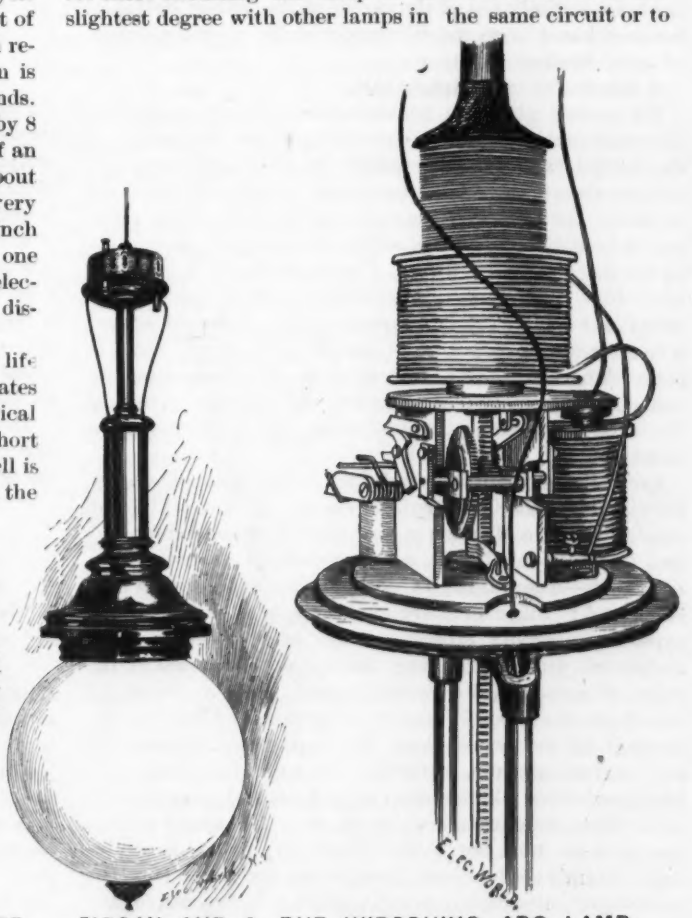
FIG. 2.—COLGATE SECONDARY BATTERY PLATE.

The Wirsching Arc Lamp.

Though the arc lamp of the present day has been brought to a high state of perfection, in many respects there is still room for improvement, especially as regards efficiency, perfect regulation and neatness and compactness of design. The lamp which is shown in the accompanying illustrations, and which has recently been put upon the market by Wirsching & Sons, Centre street, New York City, is claimed to meet these requirements in a very satisfactory manner.

The construction of the lamp is comparatively simple and the mechanism is so positive in its action that it is practically impossible for it to fail. It consists essentially of a carbon rod with teeth on one edge, so as to form a rack, into which gears a small pinion. This pinion is connected by means of a simple train of mechanism to an escapement wheel and an escapement which acts in the ordinary way. The whole of this mechanism is mounted upon a movable frame. Connected with the escapement is a balance lever, the top of which is notched. Just above this is another lever, or detent, with a tooth pivoted at one end, which is in a position to engage with the serrated top of the lever of the escapement. To one arm of this movable framework is connected the hollow core of a differentially wound solenoid, through which passes the carbon rod. Any movement of this core throws the whole frame up and down, and brings into connection with or releases the escapement lever from the tooth above it. The action of the lamp is as follows: Suppose both the carbons are separated to their normal distance and the current is turned on. All the current passes through the fine wire coil of the solenoid and the movable core is thrown up; this throws the clock work mechanism down so that the escapement is released from its controlling detent and the carbon rod from its own weight falls with a movement which is perfectly steady, since it is controlled by the escapement. As soon as the carbons come in contact the circuit is closed through the coarse wire winding of the solenoid and the core is drawn down, which raises the mechanism, brings the escapement lever into gear with its detent and prevents any further movement of the carbon rod. It will be seen that the differential windings will so adjust themselves to the regulation of the arc that the carbons will always be kept at exactly the proper distance, and the moment that anything disturbs this normal condition the immediate action of the solenoid remedies the trouble.

In case there should be any mechanical injury to the carbons or any other serious trouble arise, a device is provided for short circuiting the lamp so as not to interfere in the slightest degree with other lamps in the same circuit or to destroy the lamp itself. This is accomplished by having a contact connected with the movable core of the solenoid, so that the fine wire winding will draw it up so to make connection with a second contact, which leads directly to one of the binding posts of the lamp and completes the short circuit.



FIGS. 1 AND 2.—THE WIRSCHING ARC LAMP.

In addition to the excellence of the electrical details of this lamp, it is very compact and ornamental in appearance and the workmanship throughout is of the very best. In case the lamp is to be used on incandescent circuits a resistance is provided in the top of the lamp which, practically, occupies no space, is perfectly ventilated and entirely sufficient to control the lamp. This is rather an important point, as the arc lamp is coming more and more into use on low tension circuits.

During severe practical tests this lamp has been found to give excellent results. It burns with a clear, steady light, the feeding of the carbons is perfectly regular and there is practically none of the flickering which has often been such a disagreeable feature of the arc light.

The Frequency of Alternate and Polyphase Current Systems.

BY CHAS. P. STEINMETZ.

In THE ELECTRICAL WORLD of Aug. 8, 1892, Mr. C. E. L. Brown makes some additional remarks on my article of July 16, which are of great interest in so far as they mark the beginning of the decline in the boom of the three-phase system. I may be allowed to add only a few words with regard to the frequency of alternating currents, to correct a misunderstanding of a remark in my former article, which, indeed, seems to be due mainly to the editorial note on this previous article. There I called it an "*accidental circumstance*" that the frequency used on the Continent is somewhat less than one-third that customary on our alternating current lines.

This remark evidently did not refer to special plants, where frequency, E. M. F., size of units, etc., are chosen by the designing engineer, to suit best the purpose of the plant, as no one ever doubted that it has been done, and was necessary in the Frankfort-Lauffen transmission, as I pointed out a considerable time before the erection of this plant, in an article "On the Limits of High Pressure Power Transmission," in the *Electrical Engineer* and the *Electrotechnische Zeitschrift*, an article which brought me the enmity of some gentlemen, who were sure of the impossibility of such a plant because of the condenser capacity of the line, but have grown very silent now. My remarks referred to the numerous alternating current distributing stations which were established for lighting purposes long before the alternating motor entered the field, and which would like to furnish current for alternating motors now, if the alternating motor could accommodate itself to the frequency used on these lines. It is in these cases of alternating current light and power distribution, where the frequency, so far as the alternating motor is concerned, is an accidental circumstance—that is, a quantity chosen without any regard to the conditions of alternating motors. Here it is that the customary low frequency of the Continental lines has permitted the successful working of motors, which were a decided failure here on our high frequency lines.

The reasons why on the Continent a comparatively low frequency of 40 to 50 periods per second has been adopted, and here exclusively frequencies of 120 to 150 periods are used, are entirely out of the choice of the motor designer, because based upon the differences in the very conditions of social life here and there.

A few words may explain this.

For special plants to transmit power by alternating or polyphase currents the frequency is at the disposition of the designer and will consequently be chosen as low as possible to obviate the difficulties caused by self-induction and capacity, but still high enough to allow economical working of inductive apparatus, as transformers and generators, of the size chosen as units. Consequently, in a plant of such high capacity as the Frankfort Lauffen transmission, using only a few very large transformers, I should expect a frequency as low as 20 to 40 periods per second, while in some American power transmissions by alternating currents and by means of ordinary alternating dynamos as synchronous motors, a considerably higher frequency is employed.

Quite different are the conditions in the field of electric lighting. On the Continent the electric light is still decidedly a luxury, and when a city intends to introduce it—first certainly only for the denser populated and better situated parts—a committee of city officials and business men is elected; this committee again elects a committee of experts—university professors—and after meeting for a couple of years and filling the vacancies caused by the death of members, the committees get so far as to ask for bids from the electric supply companies. After careful study of all the propositions, for continuous, alternating, etc., current systems, naturally the committee know still less than before which system is the best, and consequently some more committees are elected, etc. It may not always last quite as long, but I remember, as I began to study, some committees had been considering for some time the question of introducing electric lighting in this university city, and a few months ago the lighting station opened on a limited scale.

Now, the consequence of this method is, that alternate and continuous current systems are co-ordinate and competitors, both supplying only denser populated districts, and where the alternating system is chosen it is used only because it allows the supply of a larger area from one central station, and the location of the central station in the suburbs. But the consumers living near together, a secondary network can reach them, and consequently the transformer is used as secondary or sub-station, feeding into a secondary network which supplies many consumers. Large units of transformers are used then, and they are cut out or cut in according to the fluctuations of load, the secondary mains being usually interconnected with each other. Because of the larger size of transformers, they can be worked very economically with low frequency, and consequently low frequency is used on the Continent, the more as direct coupled slow speed engines are preferred.

Quite different is it in the United States. Here the electric light has become a necessity of every-day life. The alternating current, entering the field, found the denser populated city districts occupied already by continuous current systems, which distributed light and power, and in this latter respect were superior to the alternating systems of those days.

But in the suburbs, in smaller cities and scattered districts, the alternating current found a field of application where the continuous current was entirely out of competition.

Mainly due to the higher standard of living, the social conditions are different here in so far as apartment and tenement houses are greatly disliked, and consequently (except in the centres of large cities) the houses are mostly small and occupied by one or two families only. On this account the population is scattered over a very much larger area than in any European city, and much less separated into poorer and better situated districts. Scattered over a larger area, the different consumers of electric light cannot be reached any more by a secondary network, but are too far apart generally to allow the use of one transformer for several customers.

In consequence of this the European system of transformer sub-station and secondary distributing mains is not applicable, but the individual consumers can be reached only by the primary mains, and have to be provided with separate transformers of smaller size.

Because of this, smaller units of generators are used, and lower pressure in the primary mains, which in this system are at the same time the distributing mains, 1,000 volts being generally used.

Since electric light is no longer a luxury, small first cost becomes essential, and this can be combined with a large number of small transformer units and economical working only by the use of a high frequency.

In this way the high frequency employed throughout in this country is necessitated by the direct primary distribution to the customers, caused by the social conditions of living. These conditions make a change to a lower frequency very unlikely for a long time to come, and at the same time answer the proposition, which comes up every few months, to introduce the more economical European system of transformer sub-stations and larger units, in the negative. For the same reason, arc lighting is done almost exclusively by series connection in high pressure circuits of 3,000 to 5,000 volts. But for special power-*transmitting* plants, indeed, no such conditions enforce the use of high frequencies, and in these cases the alternating motor can and has found a field of application already.

EICKEMEYER LABORATORY, Aug. 20, 1892.

Fireproof Insulation.

BY REGINALD A. FESSENDEN.

Fires from electric wires laid in metal conduits are an impossibility, and fires from switch and fuse boards are simply a question of proper design. There is, however, always a danger from the use of flexible cords or pendent lamps, especially when hung near curtains or tapestry. The only safety in this case is in the use of a fire and water proof, flexible insulation. There is not at present such an insulation on the market, and I do not think such a thing is known to electricians. It may, therefore, be of interest if I describe a class of substances which have these properties, and which have been actually subjected to the most severe tests.

There are a large number of substances which have the property of rendering fabrics non-inflammable, such as tungstate, borate and silicate of soda, gelatine, dextrine, etc., but they are all soluble in water, and are not good insulators of themselves. There are an equally large number of substances, both fire and water proof, but these are not flexible. It has been attempted to make a fire and water proof wire by putting an outside waterproof coat over an inside fireproof one. This method has had, however, no success, and I can state from my personal experience and tests that such wires are little, if at all, better, as regards liability to catch fire when excessive current is passed through them than ordinary rubber covered wire is. Almost since the beginning of the electric light industry, Mr. Edison has had experimenters working on this subject, and in 1889 it fell to the lot of the writer to take up the work, and to discover, in the process of "substitution," a practical method of obtaining the wished for results.

AN ILLUSTRATION OF SUBSTITUTION.

Before explaining the actual working method, it will be necessary to explain what is meant by substitution. If we construct a lazy tongs out of strips of wood and iron (the wood being shown by the dotted lines in the figure), the product will have certain properties, for instance, it can be stretched out or closed up without any great effort; but it will resist a force tending to bend it aside or twist it. It will also be destroyed, or lose its properties if subjected to the action of fire. It will also have a certain weight.

If we take out the wooden strips and replace them by copper, it will no longer be inflammable, and its weight will be somewhat increased, but its other properties, its ability to resist bending, etc., will remain the same.

In a similar way, the physical properties of such a substance as paraffine do not depend on the nature of the atoms of which it consists, so much as on the manner in which they are joined up, and we can take out some of the atoms and substitute others for them, and still leave many of the properties of the paraffine the same, while exchanging its undesirable ones for new ones, such as we wish.

Paraffine is made up of two kinds of atoms—carbon and hydrogen ones. Carbon by itself is not inflammable, and if we hold a match to a piece of graphite or to a diamond, there will be very little effect. It is the hydrogen that causes the combustion; it catches fire easily itself, and by the heat so produced raises the carbon to such a temperature that it can catch fire, too. Suppose we take out the hydrogen atoms from paraffine, and put atoms of some other element, such as chlorine, which does not catch fire, in their place. In this case we would get a substance very much like paraffine—colorless, tasteless, odorless, unaffected by water or acids, and flexible. But it is now heavier than before; is more easily acted on by alkalies, and, what is of more importance, is now absolutely uninflammable, and may be held in a Bunsen flame till it is reduced to charcoal, without showing any more signs of ignition than a piece of marble.

Paraffine is, of course, not the only substance which can be treated this way; in fact, any hydrocarbon can be made non-inflammable by this process. Unfortunately, india rubber loses its elasticity under this treatment, as its elasticity comes from a different cause from that which makes the flexibility of asphalt and paraffine.* It is evident that by boiling flexible cords in such materials as are described above we can make them not only waterproof and insulating, but also absolutely non-inflammable. In testing the insulating properties of such substances, lengths of several hundred feet of wire, coated only with these substances, were coiled up in tubes of salt water. After the lapse of several months the insulation was still too high to be measured on an ordinary Wheatstone bridge; the insulation was not acted on in the least by the salt water, while samples now three years old show no signs of deterioration. The practical method of obtaining these substances is very simple. The asphalt or paraffine is heated till it melts, and a stream of chlorine gas is passed into it. Of every two atoms of chlorine gas that goes in, one unites itself with an atom of hydrogen and passes off as H Cl, the other takes the place of the hydrogen atom. This goes on till enough of the hydrogen has been substituted by chlorine to render the substance non-inflammable. The substance is then taken out, and, still kept in the melted state, is washed with boiling water in a machine like an ice cream freezer, till all the acid remaining has been thoroughly washed away. It is then allowed to cool, and is masticated to remove the remaining water, when it is ready for use in any of the ordinary manners. Carriers of chlorine, such as antimony pentachloride, may also be used in the process. Of course, the different hydrocarbons behave somewhat differently during treatment. Paraffine first turns to a fluid, and then as more chlorine is passed in, becomes solid again. Benzole remains fluid, but on cooling, the fireproof hexachloride separates out looking exactly like paraffine; never melting, however, at a higher temperature.

The method which it was actually proposed to use, and for which, by Mr. Edison's orders, the plans for a factory to produce 1,000 pounds per day were drawn up, is as follows:

100 parts linseed oil, 50 parts strained Mexican asphalt, and 10 parts zinc chloride, are boiled down at 300 deg. C., till all the zinc chloride has combined with the other materials. The mixture is then put in a sort of ice cream freezer, and stirred up while 50 parts of antimony pentachloride are run in, the mixture being kept cool by a water jacket. After stirring for an hour, boiling water is run in, and the mixture heated by passing steam into the water jacket. After mixing for another hour all the free acid will be found to be washed out, and the material is then ready to be applied to the wire.

This gives a dark product, however, and is, moreover, more expensive than the products obtained by simply passing chlorine into hydrocarbons, and then washing them. Pentachloride of antimony costs 10 cents per pound and zinc chloride about 12 cents, so that the total cost of a pound of the fireproof material described above is about 25 cents per pound, exclusive of labor, which will probably add 15 cents more.

I should say that this method of making a fireproof insulating material, though invented and worked out by the writer, is the property of Mr. Edison, the work having been done by the writer while employed in his laboratory for that purpose. This account would not, therefore, have been published but for the fact that while it is now four years since the process was worked out, nothing appears to have been done in the matter since the writer left that company, and it seemed a pity that what is believed to be a most useful process should become a lost art.

It may be mentioned that the gases given off from these materials when heated to such a temperature as to cause decomposition will not support combustion. For instance, if wood shavings are partly covered with the composition, and placed in a box and lit, so soon as the grayish decomposition vapors begin to come off freely the fire is put out.

*See article on this subject, *Science*, July 22, 1892.

Electro-Metallurgy.—XI.*

BY F. M. F. CAZIN.

12.—HOW ELECTRIC ENERGY APPLIES ITSELF TO ELECTROLYTIC PURPOSES.

In the preceding chapters it has been shown: (1) That there is a certain quantity of electric pressure conditional to the disunion of any specified compound; (2) that the quantity of cathion is dependent upon the electric current or electric quantity as distinct from electric quality, head or pressure; (3) that a measurable quantity of electric energy is conditional to a measurable quantity of electrolytic reaction.

Does all this mean that an E. M. F. of any pressure will disengage a cathion precisely proportionate to

$$\frac{C}{Q} =$$

Electric current represented by quantity of metal disengaged
Quantity of cathion per coulomb,

and that a surplus of electric energy, consisting in electric pressure, will be ineffective, and lost in electrolytic action?

Referring to what was stated in response to this query on page 107, the author knows but one effective way of explaining the fact that, and the manner in which, such apparently superflous energy nevertheless applies itself effectively and automatically. And this effective way is once more the comparison of the electric current with the water jet. The action and effect of the water jet ejected under pressure is represented by

$$P = f\,v \times \begin{cases} S = \\ \dfrac{v^2}{2\,g} \end{cases}$$

f signifying the transverse section of the current (jet):

v signifying the velocity of the ejected water, or distance of flow per second;

S signifying the head (or pressure) under which the water is ejected: that is, the total distance of its fall preceding its ejection: and

g signifying twice the distance any matter falling on the earth will fall in the first second of such fall.

It then should not be overlooked, that (1) the factor $f\,v$ represents the volume and quantity of water ejected per second, in which factor f is analogous to ampère and v is analogous to the factor that changes the ampère into the coulomb—that is, the factor of quantity measured by time; (2) the value v which occurs in both of the main factors, that is, for "head" as well as for "quantity per second," must be identical in both, and must change in one factor if it changes in the other. To assume analogy between the laws governing kinetic and electric energy is in this case reduced to the assumption that under higher electric pressure there be a greater velocity of current, or that the quantity of electric energy per coulomb be higher under increased pressure than it is under decreased pressure.

This quoted equation of kinetic energy is analogous to the one for electric energy as expressed by

$$E = C \times R,$$

the total value E remaining unchanged, though in $E = C\,n \times \dfrac{R}{n}$ each factor be altered.

And in analogy and under the absolute necessity of maintaining the true effect of and conforming with the known laws of gravitation, the kinetic equation would read as follows:

$$P = \begin{cases} (f\,v)\,n \times \dfrac{S}{n} \\ f\,(\sqrt{n})^3\,(v \div \sqrt{n}) \times \dfrac{(v \div \sqrt{n})^2}{2\,g} \end{cases}$$

or as

$$P = \left[f\,n^3 \times \frac{v}{n} \right] \times \frac{\left(\dfrac{v}{n}\right)^2}{2\,g}$$

This equation reads in words as follows:

The same total of kinetic force is effected, although the head of the water jet be the nth part only of another jet, if the transverse section of the jet with reduced "head" be multiplied by "$n \times \sqrt{n}$," or by $\sqrt{n^3}$.

Transferred to the electric corresponding equation, the same would read:

$$E = \frac{C\,n^3}{n} \times R\,n^2,$$

and inversely the kinetic equation would read:

$$P = \frac{f\,v}{n} \times \begin{cases} n\,S = \\ \dfrac{(v\sqrt{n})^2}{2\,g} \end{cases}$$

$$\text{or } P = \frac{f}{n^3}\,v\,n \times \frac{(v\,n)^2}{2g}$$

and as a result the following theories may be stated:

The same total of kinetic force is effected though the transverse section of a water jet be lessened to $\dfrac{1}{n}$ of its original area, if the head of the same jet is increased, multiplied by n^3.

*For the tenth section of this series see THE ELECTRICAL WORLD of Aug. 20, 1892.

Transferred to the electric analogous equation this would read:

$$E = \frac{C\,n}{n^3} \times R\,n^2$$

leaving Ohm's law intact as it stands, but conflicting with the application hitherto made of it to electrolysis and to the practical measurment of electrical energy.

But as $v\,n$ represent the velocity of current, that is, the distance per second, and as in $C\,n$ the n represents the factor by which the ampère becomes a coulomb to which the quantity Q of cathion relates, so it would appear by analogy that "as the electric pressure is increased by the coeficient n^2 in electrolytic action as against the resistance offered by the electrolyte, so the cathion is increased by the coeficient n^3."

Nevertheless it is true in economical practice,

(1) That proportionate to pressure generated should be the series of passive cells to be thereby operated, and

(2) That proportionate to volume of current (ampères) is the number of passive cells that may be arranged in parallel, and

(3) That a disproportion in resistance and volume of electric energy to the direct requirements of the passive cells affected thereby equalizes itself by increasing the quantity of cathion by the cube, as the resistance increases beyond direct requirement by the square, when the arrangements of passive cells comply with the factors for pressure and current in the electric energy applied.

The latter fact is illustrated by:

$$E\,n + E\,m = \begin{cases} \left(\dfrac{C\,n^3}{n} \times \dfrac{R}{n^2}\right) \div \left(\dfrac{C\,m^3}{m} \times \dfrac{R}{m^2}\right) \\ \begin{cases} \text{Coulomb} = \\ \dfrac{C}{n} = Q \end{cases} \Bigg\} n^3 \times \dfrac{R}{n^2} \div \left(\text{Coulomb}\,m^3 \times \dfrac{R}{m^2}\right) \\ \left(Q\,n^3 \times \dfrac{R}{n^2}\right) \div \left(Q\,m^3 \times \dfrac{R}{m^2}\right) \end{cases}$$

Having thus shown in which manner electric energy applies itself to the needs of electrolysis, it is opportune to now consider the generators of such free electric energy for practical use.

The action of the active cell as a generator has already been considered. The electrolytic cell is active when the value $R = \dfrac{c\,N}{c\,P} \times c\,V$, representing the reaction in connection with the anode, is higher than the same value representing the reaction taking place at the cathode.

This difference is never large, and an accumulation of electric pressure obtained by cells set in series results in a cumbersome contrivance, for which we possess a better substitute in the dynamo, a machine in which mechanical energy is modified into free electric energy.

The fundamental facts on which the construction of the dynamo is based are:

1. The faculty of an electric current to cause a magnet to move.

2. The faculty of a moving magnet to disengage neutral or latent electric energy into the + and — current of free electric energy.

The description of the construction and operation of the dynamo is a matter of general electrics and not of electro-metallurgy. For all that is desirable to the electro-metallurgist to know of dynamos and motors, reference is made to Carl Hering's book, "Principles of Dynamo-Electric Machines," and the author refers to this book in preference to all others treating the same subject, because it follows the tendency of clearly stating the related facts and of simplifying their description and application.

It then remains to speak of the method of determining on the character of the dynamo wanted. A practical illustration of how the selection is made is offered by what Messrs. Siemens & Halske, of Berlin and Chicago, furnish when they undertake to guarantee the product.

For a production of 1,040 kilogrammes of copper per 24 hours, that is, of $12\frac{1}{27}$ grammes per second, for which theoretically $\dfrac{12.037037}{0.000316} = 38{,}091$ ampères would be required, they furnish 4 dynamos ($c\,H_{14}$) with $4 \times 400 = 1{,}600$ ampères capacity, or with only $\dfrac{1{,}600}{38{,}091} = \frac{1}{24}$ of the theoretical ampèrage. But these dynamos possess a voltage of 30, and as the requirement is only $= 2 \times \dfrac{c\,N}{c\,P} \times c\,V = 2 \times 1 \times 1.5 = 3$ volts, they are of a $\dfrac{30}{3} = 10$-fold capacity, as far as voltage be concerned. The ampèrage increases, therefore, as $\left(\sqrt{10}\right)^3 = 32$-fold.

Therefore provision is made for $\dfrac{32}{24} = 1\frac{1}{3}$ times the theoretical requirements, as the result of practical test and adaptation. Manufacturers of dynamos are prepared to guarantee their electrolytic capacity, and such guarantee is preferable to the assumption of risk on the basis of calculation by the practical metallurgist. Of the adequate arrangement of passive cells proper mention will be made when describing in the next part the general apparatus employed in electro-metallurgical practice.

Electric Railway Litigation.—I.*

BY RALPH STONE.

Editor of Michigan Law Journal.

The application of electricity to a vast number of practical uses has given birth to many novel legal questions. The law of electricity is rapidly becoming a special branch of the law, and the decisions of the courts upon questions involving the telegraph, the telephone, the electric light, the electric railway, and other electrical appliances are multiplying with great rapidity.

Very few people realize or appreciate the multitude of practical purposes to which electricity is put. Besides the telegraph, the law concerning which is quite firmly established, electricity plays the principal part in the construction and operation of the telephone, electric light and electric railway. It is extensively used as a motive power, running machinery of every description, from the sewing machine to the trip-hammer. It is employed in electro-plating, smelting, welding and heating. Launches are propelled, the soil is plowed and clocks are made self-winding by electric appliances. Electricity is an important, useful and powerful agent in time of war. Torpedoes, range-finders and search lights are operated by its agency. Electrical instruments are in common use in dentistry, photography, experimental physics and for scientific purposes generally. Electricity is employed in hotels, in conjunction with a number of appliances of convenience, such as electric call bells, annunciators, fire alarms, etc. It is an efficacious medical remedy. The largest mines of the country are worked by electrical mining machinery of various kinds. The police patrol is now regulated by electricity. Criminals, condemned to punishment for capital crimes, are put to death by an electric shock. It is possible now to send telegrams from moving trains. Block and road crossing signals are operated by electricity. The work of compiling the last census was very materially lessened by the use of electrical tabulating machines and registers. In Sweden electricity is used for agricultural purposes, to hasten the growth of plants by spreading an artificial warmth through the surface of the earth. In England it has been utilized in tanning leather, so that the operation is reduced from eight months to four days. By the ingenious manipulation of electrical devices music can be transmitted from concert halls to private dwellings.

These are only a few of the manifold, strange and ingenious, but practical uses to which this wonderful form of energy is put, but they will serve to illustrate what an important part it is destined to play in the business and commerce of the world. Following the introduction of electricity have come many legal questions of novelty and difficulty, and many more are bound to appear.

Although electricity, as a motive power for street railways, has been in general use but four years, considerable litigation has already arisen over: (1) the authority of the electric railway to use the public highway; (2) the rights of owners of abutting property against the electric railway; (3) the liability of the electric railway to the telephone company for alleged interference of the former with the proper use of the latter, by leakage and induction, and (4) the liability of the railway company for injuries to third persons.

Four years ago there were only thirteen electric street railways in the United States. Now there are over four hundred, and the number is rapidly increasing. It was not until 1888 that the electric railway became a practical commercial success, and the litigation that has arisen, because of the utilization of electricity as a motive power upon street railways, dates from that time. The different methods of electric street railway construction thus far attempted are four in number, viz.: (1) Storage battery; (2) conduit system; (3) double trolley; and (4) single trolley. In order to comprehend the legal points involved in a large number of electric railway controversies, it is necessary at least to understand the main differences between these methods. The single trolley is the only one which has proved financially and commercially successful, but electrical inventors are now at work endeavoring to perfect the storage battery, which is, of course, the ideal system of street transportation, and the conduit system, which at present appears to be the more practicable.

1. The storage battery car is driven, as the name indicates, by electrical power stored in the car itself, but because of the rapid deterioration of the batteries, their great weight, and the necessity of frequently re-charging them, it has been almost entirely abandoned. It is now but little considered in the field of electric traction, except in reference to future possibilities. The storage battery car is practicable only upon those streets which are quite level. It has been tried, among other places, on Madison avenue, New York; Washington, D. C., and Dubuque, Ia.

2. The conduit system, or underground method, *i. e.*, where the continuous live conductor is placed in an open-slotted conduit, is not as yet a success in this country, its fatal weakness being the inability of its operators to pre-

*From *The New Jersey Law Journal.*

vent the conduit from becoming filled with water, mud, etc. It has been successfully operated in Budapest, however, and as the problem of drainage is one with which American engineers are as capable of coping as foreign engineers, it is probable that this defect will be remedied, and that the overhead wires will be placed underground.

3 and 4. The double trolley system is merely the single trolley without a ground return. In other words, in the double trolley system a wire is used for the direct return of the current, while in the single trolley system, which is used on nine-tenths of the electric roads now in operation, the earth is used for a return circuit.

I. THE AUTHORITY OF THE ELECTRIC RAILWAY TO USE THE PUBLIC HIGHWAY.

The public easement in the highway is vested in the public, and can be divested by nothing short of an exercise of sovereign power. 2 Dillon on Municipal Corporations, 4th ed., § 656. The legislature, as representing the public, has (in the absence of constitutional restraint, and subject to the property rights and easements of the abutting owner) full and paramount authority over all public ways and public places. 2 Dillon on Municipal Corporations, 4th ed., 656 (518), and cases cited. The authority of municipalities over streets and the uses to which they may be put depends entirely upon their charters or the legislative enactments applicable to them. 2 Dillon on Municipal Corporations, 4th ed., 680 (538). It is held, however, that a municipality cannot confer franchises upon corporations organized for the purpose of operating horse railroads, Id., 717, 725, although it may authorize the streets to be used for many other purposes of public conveyance other than travel or transportation, as to lay sewers. Id., 689 (542); Traphagan v. Jersey City, 29 N. J. Law, 206; State v. Hoboken, 45 N. J. Law, 482; and to lay gas pipes. Attorney General v. Cincinnati Gas, etc., Co., 18 Ohio St., 262; Indianapolis v. Indianapolis Gas, etc., Co., 66 Ind., 396; 2 Dillon on Municipal Corporations, 692 (547).

Street cars operated by animal power may be authorized by the legislature, and the abutting owner is not entitled to compensation. Attorney General v. Metropolian R. Co., 125 Mass., 515; Sears v. Marshallton St. R. Co., 65 Iowa, 742. The electric railway, therefore, should apply for a corporate franchise to the legislature, and secure permission by ordinance from the city to use the streets for the purpose of transporting passengers.

The right to operate an ordinary steam railway in the streets, which is not consistent with the use of the streets for ordinary purposes, cannot be granted by the city. 2 Dillon on Municipal Corporations, 705 (558); Pierce on Railroads, 234; Angell on Highways, 91, note; 25 American Law Register [N. S.], 431 and cases cited, or by the legislature, except upon payment of compensation to abutting owners. 2 Dillon on Municipal Corporations, 705; Grand Rapids & Ind. R. Co. v. Heisel, 38 Mich., 62; Story v. New York Elevated R. Co., 90 N. Y., 122; Lahr v. Metropolitan El. R. Co., 104 N. Y., 268.

The electric railway applies to the legislature for its franchise because in that body rests the public easement in the street, and it deals with the city because, usually by their charters, municipalities are granted control over the streets for certain purposes. The steam railroad is not permitted to use the streets except upon compensation to abutting owners, while the horse railway is permitted to occupy the streets without such compensation. The inquiry next presents itself, Can the electric railway be authorized to occupy the streets, or, in other words, is it to be classed with the steam railroad or the horse railway?

In Michigan it has been held that the legislature has expressly conferred upon the cities of the State the right to authorize the use of any motive power whatever upon their street railways (Act No. 148, Laws of 1855, amended 1867), which includes the right to authorize the use of electricity. Chap. 984, How. Stat., and How. Stat., sections 3,495 and 3,533; Detroit City R'y v. Mills, 85 Mich., 634; see able dissenting opinion. Williams v. City Elect. St. R. Co., 41 Fed. Rep., 556.

In the case of the State, Eleanor Green, Prosecutor, v. the Inhabitants of the City of Trenton and the Trenton Horse Railroad Company (N. J. L. J., February, 1892, opinion filed January, 1892), by writ of certiorari, an ordinance was brought into court which was passed by the Common Council of the city of Trenton, giving permission to the Trenton Horse Railroad Company to use electric motors to be supplied with electricity from properly guarded overhead wires supported by poles. The Supreme Court of New Jersey held that the provision of the act (Rev. Supp., p. 369, section 30, passed March 6, 1866) empowering the street railways, with the consent of the municipal authorities, to use electric or chemical motors or grip cables as the propelling power of their cars instead of horses, did not legalize the erection of poles and the stretching of wires in a public street as a part of a system of electrical railroading, and that the ordinance which purported to grant permission to erect such poles and stretch such wires was illegal. The court reasoned that, since from the evidence it appeared that the single trolley overhead system had not been in practical operation at the time of the passage of this act, 1886, there was nothing to indicate that the legislature, from its knowledge of "electric motors," could have intended anything more than the storage battery or underground conduit, which were the only systems then experimented with to any extent.* The court also decided that "the act contains no implied grant of power to obstruct the ordinary use of a public street by posts, wires or any other apparatus designed to be used in connection with an electric motor," and concluded that the common council had no power to authorize or consent to anything more than to the use of an electric motor. It is perceived, however, that this opinion does not rest upon the want of power in the legislature to authorize the erection of poles and wires upon the land of an abutting owner, without compensation, upon which question no opinion is expressed, but rests upon the intention of the legislature, as expressed in the act of 1886. See also State v. Newark and Newark Pass. R. Co. (opinion filed January, 1892), 15 N. J. L. J., 45.

If a horse railway company has been authorized to use the streets, a change of motive power is of no consequence unless the power is a nuisance. Lockhart v. Craig St. R. Co., 139 Pa. St., 419; Williams v. City Elect. R. Co., 41 Fed. Rep., 556; Taggart v. Newport St. R. Co., 16 R. I., 668; Halsey v. Rapid Transit St. R. Co., 47 N. J. Equity, 380. This change may be authorized either by the legislature, 47 N. J. Equity, 380, *supra*, or by the city under its charter power: 16 R. I., 668, *supra;* 85 Mich., 634, *supra;* Thompson on the Law of Electricity, pp. 29, 51.

Therefore, passing by, for the present, the question as to whether the electric power is a nuisance or not, the courts are, it seems, of the opinion that, under the general grant of power from the legislature to maintain and operate a street railway, a corporation takes, by necessary and unavoidable implication, a right to use any force (as electricity) in the propulsion of its cars that may be fit and appropriate to that end.

* It appears, however, from the editor's note to this case, that the evidence was that there were five railways in operation in this country by the trolley system before March 6, 1886, and that only two cars had been run experimentally by the storage battery, both of them in Europe.

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Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.

A. D. 1800.——William Nicholson, editor of the journal bearing his name, as well as an able chemist, and Sir Anthony (then Mr.) Carlisle, an English surgeon, while carrying on a series of chemical experiments, discovered that by means of the voltaic pile water is decomposed into its constituents of oxygen and hydrogen. They made a pile of 17 silver half-crown pieces alternated with equal discs of copper and cloth soaked in a weak solution of ordinary salt, and, having used a little water to make good the contact of the conducting wire with a plate to which the electricity was to be transmitted, Carlisle observed that gas was being set free in the water, while Nicholson recognized the odor of hydrogen proceeding from it. The better to observe this result they afterward, May 2, 1800, employed a small glass tube, which, after being filled with water, was stopped at both ends with corks through which passed two brass wires extending a little distance into the water. When the wires were properly connected with the pile, bulbs of hydrogen gas appeared from the negative end of the wire while the positive end became tarnished through oxidation. When platinum wires were used, gas bubbles appeared from both wires, and the two gases, hydrogen from the negative and oxygen from the positive end, were found to be nearly in the proportion to constitute water.[1]

During the year 1781 William Nicholson had published the first edition of "An Introduction to Natural Philosophy." In the second section of the third book of the latter work he treats of magnetism, the methods of communicating it, and the variation of the compass. The loadstone, he says, "is a ponderous ore of iron, usually of a dirty black color and hard enough to emit sparks with steel. It is found in most parts of the world, and possesses a natural magnetism acquired most probably from its situation or position with respect to the earth." In the third section of the same third book he discourses upon electrical matter, electrical jars, electrical instruments, and devotes much space to the explanation of experiments and facts touching natural and atmospheric electricity, balls of fire, of the *ignis fatuus*, or will-with-the-wisp, of waterspouts, earthquakes, etc., alluding to most of the then well known observations thereon recorded by different scientists.

To Mr. Nicholson is due the invention of the revolving doubler, an improvement upon that of the Rev. Mr. Bennet (A. D. 1787), which is described and illustrated in the "Encyclopædia Britannica," as well as in No. 647, page 10,327, of the *Sci. Am. Supplement*.[2]

The above named discovery of Nicholson and Carlisle, which, Mr. Davy says (*Phil. Trans.* for 1806, page 386) was the true origin of all that has been done in electro-chemical science, together with Hisinger and Berzelius' decomposition of salts, and the successful decomposition of ammonia, nitric acid, etc., made by the distinguished English chemical philosopher, Dr. William Henry,[3] as well as Davy's decomposition of the earths and alkalies, creates at the commencement of another century, as we have already observed, an entirely new epoch in the history of chemistry.[4]

A. D. 1800.——Grout (Jonathan, Jr.), of Belchertown, Mass., takes out, October 24, the first telegraph patent in the United States. It was for a contrivance which he operated between Martha's Vineyard and Boston, about ninety miles distance, from hilltop to hilltop, and which was sighted by telescopes.[5]

A. D. 1800.——Cruikshanks (William), of Woolwich, England, confirms Nicholson and Carlisle's experiments, and, in his further prosecution of them employs a pile consisting of from 40 to 100 pairs of zinc and silver plates, as well as a tube holding silver terminals or electrodes, in place of platinum electrodes, which they were first to make use of.

He discovers that hydrogen is always evolved from the silver or copper end of the voltaic pile and oxygen from the other; that, under like circumstances, metals can be "completely revived" from their solutions, the reduced metal being deposited upon the wire; that pure oxygen is freed when a wire of non-oxidizdable metal, like gold, is connected with the zinc plate, and that fluids that contain no oxygen cannot transmit the voltaic current. These results were verified by Lieut. Col. Henry Haldane, whose many observations upon the series of metals best suited to the production of voltaic electricity and their respective powers in connection therewith are related at pages 242 and 313, vol. iv., of *Nicholson's Journal* for Sept. and Oct., 1800.

Cruikshanks was also the first to discover, in 1800, that when passing the electric current through water tinged with litmus, the wire connected with the zinc end of the pile imparted a red tinge to the fluid contiguous to it, and that by using water colored with Brazil wood, the wire connected with the silver end of the pile produced a deeper shade of color in the surrounding fluid; hence it appeared that an acid was formed in the former case, and an alkali in the latter. Fahie, who mentions this, justly remarks that upon this discovery are dependent the electro-chemical telegraphs proposed by Bakewell, Caselli, Bonelli, D'Arlincourt, Sawyer and others.

Cruikshanks is the inventor of the galvanic trough, an improvement upon the voltaic pile, made by soldering together rectangular plates of zinc and copper, and so arranging them horizontally, in a box of baked wood coated with an insulating substance, as to allow of open spaces which can be filled with a solution of salt and water or with diluted acid, to take the place of the wet plates of cloth, paper or pasteboard. Cruikshanks' plan was adopted in the construction of the powerful battery of 600 pairs, which Napoleon Bonaparte presented to the Ecole Polytechnique and upon which Gay-Lussac and Thénard made their important experiments during the year 1808. As Noad remarks, it is a very convenient form when sulphate of copper is used, for Dr. Fyfe has shown[6] that this exciting agent increases the electro-chemical intensity of the electric current as compared with that evolved by dilute sulphuric acid in the proportion of 72 to 16.

Although both the above and Volta's form of battery apparently answered all purposes, they were, nevertheless, much improved upon by Dr. William Babington (1756–1833), who united the pairs of zinc and copper plates by soldering them at one point, and by attaching them to a strip of wood in such a manner as to allow the entire line being immersed at will into an earthenware or wooden trough having a corresponding number of cells or partitions. This modification naturally permitted likewise the ready withdrawal of the plates from the trough so as to suspend all action and in order to admit of the cleansing and substitution of plates. The extraordinary strong voltaic battery, constructed in 1808 for the Royal Institution of London, by Mr. Eastwick, under the direction of Sir Humphrey Davy and Mr. John George Children, was built upon this plan. It consisted of 200 separate parts, each part being composed of ten double plates, in all 2,000 double plates of zinc and copper with a total surface of 128,000 square inches, and the charge which William H. Pepys was accustomed to give it consisted of a mixture of 1,168 parts of water, 108 parts nitrous acid and 25 parts sulphuric acid.[7]

[1] See account of above in Pepper's "Electricity," p. 312, as well as at pp. 193 and 194 of Fahie's "History of Telegraphy to 1837," and at pp. 339 and 340 of vol. i., of Lardner's "Lectures."

[2] See Read at A. D. 1794, also *Phil. Trans.*, vol. lxxviii., page 1, for Mr. Cavallo's remarks upon the defects in Bennet's doubler.

[3] See *Nicholson's Journal*, vol. iv., pp. 30, 209, 223 and 245; "Encyclopedia Metropolitana," vol. iv., pp. 221 and 611.

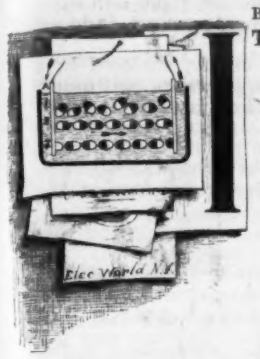
[4] See Nicholson's letter to the Royal Society, read June 5, 1788, entitled "A description of an instrument which, by the turning of a winch, produces the two states of electricity without friction or communication with the earth" (influence or induction machine); *Nicholson's Journal*, 1800, vol. iv., p. 179; Despretz, "Physique," 1827, p. 432; *Mechanics' Magazine*, Nov. 9, 1839; biography in "English Cyclopedia," vol. xi., p. 82; Tomlinson, "Cyclopedia of Arts, etc.," 1852, vol. i., p. 566; "Memoir of Joseph Henry," 1880, p. 78; Heighton, "The Electric Telegraph," p. 28; Noad, "Manual," p. 353; "Encyclopædia Britannica," 1855, vol. xxi., p. 628; *Phil Trans.*, vol. lxxix., p. 265; *Philosophical Magazine*, vol. vii., p. 337, and xlv., p. 396; C. H. Wilkinson, "Elements of Galvanism," 1804, vol. ii., pp. 21, 22, 46, 68, 375, etc.; "Bibl. Brit.," vol. xix., p. 274; "Sciences et Arts," part i., p. 274, and part ii., p. 339, for Volta's answer to Nicholson. For various treatises on, and methods of, effecting the decomposition of water, consult Adam W. Von. Hauch (*Mons's Jour. de Chimie*, vol. i., p. 109); G. Carradori (*Journal de Physique*, An xii., p. 20. "Nuova Scel. d' Op.," quarto, vol. i., p. 29, Paris and Milan, 1804); W. Wilson (*Phil. Mag.*, vol. xxii., p. 260); Cioni and Petroni (Brugnatelli's *An. di Chim.*, vol. ii., p. 322), 1805; M. Van Marum's letter to Nauche (*Jour du Galvan.*, 11th book, p. 187; *Gilb. Ann.*, xi., 220); J. C. Cuthbertson (*Phil. Mag.*, vol xxiv., p. 170, 1806); Jos. Mollet's Memoirs published at Aix and Lyons, 1821, 1823, as well as in the Reports of the Lyons Academy, 1823, 1825, and in the *Comptes Rendus* for 1823; Mr. Leeson (*Sturgeon's Annals*, vol. iv., p. 238, 1839; Robert Hare, *Trans Am Phil Soc.*, N. S., vol. vi., p. 339; L. Palmieri and P. Linari-Santi, "Telluro-Elettricismo," 1844; M. Merget's Theses, read before the Paris Academy, Aug. 30, 1849; A. Connel, *Phil. Mag.*, 4th Ser., for June, 1854, p. 426).

[5] See "Telegraph in America," J. D. Reid, 1887, p. 5; also "Growth of Industrial Art," Washington, 1888, p. 55.

[6] *Phil. Mag.*, vol. xi., p. 145.

[7] See Wilkinson, "Elements of Galvanism," 1804, vol. ii., pp. 52–63, 96–99; Pepper, "Electricity," 1809, pp. 313–315; Noad, "Manual," pp. 263, 264; Tomlinson, "Cyclopedia of Arts," vol. i., pp. 566; Napier, "Electro-Metallurgy," 1853, pp. 27, 28; *Nicholson's Journal*, vol. iv., pp. 187, 254, 261 and 511; *Sturgeon's Annals*, vol. ix., p. 309; Cruikshanks, "Some Experiments and Observations on Galvanic Electricity," July, 1800, also "Additional Remarks on Galvanic Electricity," Sept., 1800.

The Problems of Commercial Electrolysis.—I.*



BY J. SWINBURNE.

I would be idle to attempt to go over the whole subject of the technical applications of electrolysis, as, although this development of industry is of very recent growth, it is already so extensive that many of its branches demand evenings devoted exclusively to their discussion. My object is, however, to take a sort of bird's-eye view of the subject, and, if possible, to try to foresee the directions in which others must seek for future developments.

There is a very general feeling that there is a mine of untold wealth in the application of electricity to metallurgy; but chemists are not generally electricians, and electricians are seldom chemists. It seemed, therefore, advisable to bring the paper before this institution, in the hope that it will result in a discussion; and if it leads to the expression of the views, both of electrical engineers and manufacturing chemists, and to a further approach to common ground, our time will be well spent.

However puzzling the theory of electrolysis may be, for commercial purposes it may be regarded as involving no mystery. In fact, broadly speaking, we may disregard the electrical side of the question and look upon electrolysis as a method of oxidizing and reducing, and nothing more. It must be remembered, however, that there are often many ways of oxidizing the same substance. For instance, a sulphide may be oxidized into a sulphite or sulphate, or sulphur may be liberated. Electrolysis does not always afford the means of oxidizing in the particular manner desired. A very large number of the processes employed in chemical industry consist merely in oxidizing and reducing, special conditions being arranged to suit the particular substance being operated upon. Once we take this broad view, all we have to consider is, "Which of the oxidizing and reducing processes in use in chemical works can we advantageously replace by electrical methods?" In many cases electrical methods are impossible; in others they are more expensive than those at present in use; but it is hardly too much to say that in an enormous number electrolysis is destined to play a leading part in the near future.

Take, for instance, the case of reduction. This is almost universally effected by means of hot carbon, and at first sight it seems unlikely that it could pay to burn the carbon under a boiler, and get a small percentage or the energy back in the electrical form, and to utilize that portion alone. It must be remembered, however, that the methods of reduction by burning carbon are themselves exceedingly inefficient, and, moreover, they very often give impure products. By means of electrolysis, however, it is frequently possible to secure metals of the highest purity by direct processes. Before going further, it will be wise to form some idea of the cost of electrical energy in, say, a large chemical works. Of course "cost" is a loose term: we might calculate it from the cost of coal and labor and sundries; or we might add interest and depreciation, rent and superintendence. In all cases in estimating the cost, further additions have to be made for standing charges, advertising, profits, maintaining patents, etc. It is unnecessary to trouble ourselves about definitions of cost, for if it is stated how the figures are obtained, the selling price can be worked out and comparisons can be made.

Suppose a plant is put up to give a million watts; it will be found that if the plant is taken as running day and night, including Sundays, and if the best engines, with modern dynamos, are employed, the cost comes out about 0.25d. per kilowatt hour. This figure includes interest and depreciation of engines, boilers and buildings, and coal, labor and petty stores; but does not include rent or salaried superintendence. This figure will appear ridiculous to those accustomed to London central stations; but that is because central stations work under the most disadvantageous conditions possible, while a chemical works has everything in its favor.

OXIDATION AND REDUCTION.

Oxygen.—The first obvious application of electrolysis is the decomposition of water. In an acid solution platinum or lead anodes are necessary; platinum is expensive and lead takes a high electromotive force, so it would be best to use an alkaline solution with iron electrodes. Allowing two volts as he pressure required, the cost comes out at 5s. 7d. per 1,000 feet for the oxygen. The hydrogen is taken as valueless. As the output in oxygen must be small, we must take a much higher figure than the farthing per kilowatt-hour—in fact, it would be safer to double the price and say 11s. 2d. To find the selling price we must allow for packing in cylinders, and add all the trade charges, which will probably bring the price up to something like 15s. per 1,000 cubic feet. The retail price of Brinn's oxygen is 2d. per cubic foot, so there would appear to be a very large margin.

Alkali.—We come next to a subject which has already absorbed an enormous amount of labor and thought, and that is the production of caustic soda and chlorine from common salt. The Leblanc and Weldon process is exceedingly complicated and very costly; and as by simply electrolyzing salt, costing about 15s. a ton, chlorine and caustic soda can be produced, it seems, at first sight at least, most strange that electrolytic processes have not replaced all others within the last few years. Assuming that the process works, let us first form a rough idea of its probable economy. With suitable vats and a reasonable current density, we may take it that three volts is a liberal allowance. For the ton of 70 per cent. caustic soda we have—

	£	s.	d.
Electrical energy	2	15	0
Salt	1	2	6
Lime	1	3	0
	£5	0	6

For £5 we have thus obtained a ton of caustic and 1½ tons of bleaching powder. We have allowed nothing for the cost of vats, for labor at the vats and in handling, or for evaporation of causticized liquor. The ordinary caustic liquor after causticizing is quite weak, but electrolytic caustic can be made into a strong lye. On a small scale I have produced lye with 30 per cent. caustic. To do this the brine is electrolyzed and then stirred up with more salt, and so on; the process being repeated several times. Strong caustic is a good conductor, so this method is good from that point of view as well as from that of saving in evaporation. Evaporation with a Yaryan should not come to more than a shilling or two a ton extra. It would doubtless be safe to say that, taking this way of estimating the cost, a ton of caustic and a ton and a half of bleach should be made for £6. This allows an enormous margin for expenses and for profits. This method of estimating is very rough, and unless a new process worked out in this sort of way comes out with an enormous margin, it is not likely to be worthy of serious consideration. On looking into it further it will generally be found that when all the details of expenditure which will be necessary in practice are added, the margin, if it still exists, is too small. In fact, a new process must look marvelously good on paper to be really worth anything when tried commercially. Electrolytic soda and bleach seems to have an excessive margin, however, and we have to see whether there is any other weak point.

I believe the difficulty, and the only difficulty, lies in the anodes. Process after process is brought out, and each claims to have solved the problem of electrolytic soda by the use of some new arrangement of the porous partition, or by some other detail which can hardly make all the difference between success and failure. The various processes make a little excitement for a time, and then disappear, I believe because the anodes are destroyed.

Of course none of the ordinary metals can be used as anodes, as they are attacked at once. Platinum is generally supposed not to be attacked by chlorine: but I find that it is slowly eaten away. I would like to hear this confirmed or denied by others, for it is a very important point. On the one hand I find experimental anodes eaten away on the other hand we hear of platinum anodes being used extensively in the electrolysis of chlorides. Of course, in the manufacture of such a cheap commodity as soda, the capital invested in platinum anodes would be prohibitive; and the least waste of metal would lead to ruinous expenditure. The next material to consider is carbon. In 1882 Bartoli and Papasogli pointed out that carbon was attacked when used in any solution which evolves oxygen. Without knowing of their work, I found the same thing by a series of experiments carried out in 1883. In those days it was tacitly assumed that carbon with peroxide of lead could be used in the ordinary secondary batteries, without any fear of local action. Though carbon does not seem to combine with chlorine during electrolysis, I find that it is always attacked, even in a solution of salt. I have tried every kind of carbon I can think of, and the result has always been that the anode was corroded. I do not mean to say that carbon is eaten away at a rate at all corresponding to that with which the soda is formed; in comparison the corrosion is slow. It must be remembered, however, that a very slow corrosion makes carbon anodes useless when the products are cheap.

Carbon is also troublesome mechanically. It is difficult to make good contacts with it, especially when there is chlorine about. Large carbon plates are also expensive. Mr. Greenwood overcomes this last difficulty by electroplating one side of a number of comparatively small plates, and then soldering them to a plate of type metal. The type metal is not exposed to the solution anywhere, else it would be attacked by the chlorine. By this means he produces a large carbon anode with a good metallic connection.

Peroxide of lead seems to present a solution of the problem. Unfortunately, however, peroxide of lead is reduced by hydrochloric acid; and it seems to be impossible to electrolyze salt without producing some free acid at the anode. Some specimens of lithanode I tried were attacked; I do not know, though, the inexhaustible ingenuity of Mr. Fitzgerald has produced any special make which will stand traces of free acid. I am inclined to think, therefore, that progress is barred in that direction solely by the want of a good anode. If this is the case, there is a fortune awaiting the inventor who can find something which will act as an anode in a solution of common salt.

I have tried electrolyzing sodium sulphate. There is not the same margin here. You get hydrochloric acid as a by-product, instead of chlorine, so that the Weldon process would still be necessary; and the sulphuric acid would have to be concentrated every cycle, in order to act on the next batch of salt. This process would, in fact, save the black ash part of the soda process; and, like all these methods, would demand carbonic acid to make soda crystals. Of course this last is not a serious difficulty, especially if quicklime is needed to absorb the chlorine. In this case I tried lead anodes, when, to my surprise, the small traces of chloride left in the sulphate corroded the lead anodes.

Papermakers use large quantities both of caustic and bleach, and they recover soda and causticize it in their works. It would therefore be an enormous advantage to be able to produce caustic and bleach direct on their own premises. I do not know if the presence of salt would interfere in any way with the action of caustic in the grass or straw boilers, but should think not. By making the caustic on the spot a saving is effected in the processes otherwise necessary. There would be no need to concentrate the lye or to fish out the salt that may be present. Caustic drums and carriage would be saved; but, of course, against this there may be carriage of salt. The importance to paper works is so great that it is almost a question whether it would not pay to face the corrosion of the carbons, and to arrange vats so that the anodes can be easily replaced.

In the Hermite process the chlorine is not given off, but a hypochlorite is formed. Of course in this case caustic soda cannot be made. For paper works especially it is obviously cheaper to supply lime and get bleaching powder and caustic than to make sodium hypochlorite only. This may, however, depend on the anodes. Platinum anodes are used in this process, and it seems to be the case that platinum is not attacked in an alkaline chloride. If this is so, it is possible to produce hypochlorite of soda, but not caustic and bleaching powder. The Hermite process is apparently commercially successful. Magnesium chloride is generally employed in the Hermite process, but I have been told that salt is now used. It has been said that electrolytic hypochlorites, especially of magnesium, have more bleaching power than the ordinary bleaching powder. Of course a sodium, or any other hypochlorite, may be formed which has twice as much of its chlorine available, when compared with bleaching powder; but this is merely an apparent gain, as it takes twice as much electricity to produce the hypochlorite. Messrs. Cross & Bevan, however, hold that the bleaching power of these compounds is not as determined by arsenious acid. They maintain that the fibres to be bleached contain some ketones or other, and these ketones absorb some of the available chlorine, especially when provided by bleaching powder; that the hypochlorite of sodium and of calcium waste available chlorine on the useless work of chlorinating these ketones, while magnesium hypochlorite devotes its whole attention to honest bleaching. Of course, if it is slightly easier to oxidize the coloring matters than to attack the ketones, it may be the case that a hypochlorite of a weak base, like magnesium, may be able to bleach, but not to attack ketones. It would then be better than the hypochlorite of calcium, or especially sodium. These matters are better left in the hands of such authorities as Messrs. Cross & Bevan. They make out, also, that electrolytically prepared magnesium hypocholorite is best. This seems very strange. Of course it would mean that some other salt is really formed. The properties of a salt cannot depend on the method of its preparation, and there is no magic in electrolysis.

Potassium Chlorate.—The manufacture of potassium chlorate is carried out by electrolyzing a hot solution of the chloride. The chlorate is then formed instead of the hypochlorite. This process is carried out on a large scale at Vallorbes, in France, under the direction of M. Gall-de-Montlaur. It is stated that they make a ton a day, 24 h. p.-hours yielding 2.2 pounds. The power is supplied by a waterfall, so the chlorate should be very cheaply made, if the anodes are absolutely free from corrosion. Platinum anodes are employed.

*A paper read before the Institution of Electrical Engineers, London. This paper will be discussed at one of the first meetings after the recess.

The British Association Committee on Electrical Standards.

The following communication was presented by Dr. Oliver Lodge to the above committee:

In view of the hoped for presence of Prof. von Helmholtz and other distinguished foreigners at this year's meeting of the British Association in Edinburgh, it will probably be recognized as suitable to take up and continue the discussion on new electromagnetic units for practical purposes, which was begun last year at Cardiff. I therefore beg to contribute the following notes, and to conclude by moving some resolutions.

One great fact brought into prominence by the practical development of electricity is the analogy or reciprocity between the electric and the magnetic circuit, and this is the fact which it behooves us to emphasize in the naming of fresh units. The magnetic circuit has as yet no authorized names applied to it. The electric circuit is well provided, but perhaps one or two improvements can be made.

(1.) THE ELECTRIC CIRCUIT.

The first point on which I consider that practical men would do well to insist is that names shall be given to the complete things dealt with, rather than to mere coefficients. Thus of all units with which they are concerned there can be no doubt but that volt and ampère are the most prominent. These are the active things with which electrical engineers have to deal, and these are the things for which meters exist on every wall in an electric lighting station. The ohm, or unit coefficient of resistance, is comparatively academic in character; it is a constant of a coil of wire or of an underground lead; it is nothing vivid and active. The engineering use of the term ohm is mainly in connection with insulation and other high resistances; for large conductors the equivalent "volt per ampère" is perhaps more

often used. It is the drop of potential which a given conductor entails for a given current that is of real interest to an engineer, and it is this of which in large leads he consciously thinks.

A six-ohm conductor means one that drops six volts for every ampère that is sent along it. If you send three ampères along such a line, the potential at the far end is 18 volts below that at the near end. The clear realization of this fact would be almost aided by the complete title, six volts per ampère, instead of the abbreviation, six ohms. Nevertheless, the name ohm is in common use and hence may be assumed useful.

A still more useful name, however, for good conductors would really be the reciprocal of an ohm—the ampère per volt. Suppose this be called a mo, as Sir W. Thomson once suggested, then a cable of 20 mos would be one that conveyed 20 ampères with a drop of one volt. A thousand-mo cable would convey 500 ampères with a drop of half a volt, and so on. It is more directly practical to think of the ampères conveyed per drop of voltage than of the drop of voltage per ampère. I believe that some authorized name for unit conductance would be welcomed.

Units of Inconvenient Size.

The authorized name "coulomb" for unit quantity is barely used by engineers, who are content with ampère-hour, thus proving that what is needed in practical units is not so much a consistent decimal system as a set of units each of practical magnitude.

Farad.

The effort after consistency has resulted in the useless "farad;" and this should be a lesson not to try and fix units of unreasonable size. The C. G. S. units already exist as a consistent system; the only objection to them is that they are of unpractical size. The whole object of devising a practical system of units was to have things of everyday size to deal with. The volt, the ampère and the ohm satisfy this condition. The coulomb, the farad and the watt do not. Already they have practically given place to the ampère-hour, the microfarad and the kilowatt.

Considerably more progress would have been made in knowledge of ordinary capacities if the microfarad had been called the farad, so that easy submultiples of it would have been available to express the capacity of Leyden jars and such like things. The capacity of an ordinary jar would then have been a few millifarads, and a microfarad would have been the capacity of a short bit of connecting wire. I ask whether this change would introduce serious confusion even now? I think not. Nobody cares the least about "coulombs per volt," and so there is no sense or use in the present farad. Telegraphists would surely soon consent to drop the useless prefix micro; and the factor of a million is too great to render doubt possible as to what was intended, even in the transition stage. It ought to be regarded as essential to have the practical unit somewhere not hopelessly away from the middle of the range of probable multiples and submultiples.

Coulomb.

A coulomb again is almost useless as a synonym for the ampère-second; it is so easy to speak of ampère minutes or ampère hours. If the name coulomb could be set free from its present superfluous meaning it could usefully be applied to the electrostatic unit of quantity, which wants a name. Teachers would find it convenient at once, and in the apparently imminent line of development engineers might find it useful before long. It is the charge on a two-centimetre sphere at a potential of 300 volts (or on a one foot sphere at 20 volts). The capacity of the two centimetre sphere would be $\frac{9}{10}$ of a (new) microfarad.

Watt.

Lastly, with regard to the watt. The name volt-ampère is almost as good as the name watt, especially since the watt is also one joule per second.

Both names, watt and joule, are not really wanted by electricians, to whom their coexistence is rather confusing. I believe it would be more convenient to use the term watt in the sense it gets so frequently used now, viz., energy, say a volt-ampère hour; in which case a kilowatt would be synonymous with the present Board of Trade unit.

The rate of working, or power, could then be expressed in a rational and unforced way as so many watts per hour or so many volt-ampères. It is much more natural to give a name to a definite thing like a quantity of energy than it is to give it to a mere rate of working. The latter is instinctively felt to need a reference to time; just as a velocity unit has not been practically found to need a name, being quite simply expressible in feet per second or miles per hour; and even when a name has been given, like "knot," instinct constrains people to practically get rid of it again by speaking of knots per hour, just as we find "kilowatts per hour" already often used in electrical workshops. I suggest, therefore, that the present watt is too small, that it is sufficiently expressed by a joule per second, and that it would be more useful if magnified 3,600 times, and turned into a unit of energy.

That we should thus have several energy units—the erg, the joule and the watt—all of quite different sizes, is no objection, but an advantage, seeing the extreme importance of energy. Such things as length, mass, time and energy demand a fair range of units. It would be tedious to express centuries in seconds.

(2.) MAGNETIC CIRCUIT.

In speaking of the magnetic circuit I wish to refer back to my opening remarks concerning the electric circuit, and the class of things for which names should be found. In the magnetic circuit the only thing at present seriously attempted to be named is, in accordance with the historic parallel of the ohm, a coefficient or characteristic of a coil of wire—its coefficient of self-induction; the unit of which has been called variously a secohm, a quadrant and a henry.

Total Induction.

But the real active thing with which engineers are concerned is total magnetic induction, total number of lines of force across an airgap; as between the polepieces or through the armature of a dynamo, or in the circuit of a transformer. It may be called the electromagnetic momentum per turn of wire; or the surface integral of B. This total induction is in some respects analogous to electric current, and has occasionally been called magnetic current (a bad name), or "magnetic flux." It is, however, more strictly analogous to the coulomb, and its time rate of variation is the more proper representative of electric current. Its common practical name at present is "total lines," or "total induction," or "number of lines."

Now "one line" is awkward as a unit, besides being (if a C. G. S. line) inconveniently small. The earth, for instance, sends 4,400 such lines through every horizontal square metre about England; through a square inch it only sends a fraction of a line. A practically sized unit of induction badly wants a name, and "henry" would have done for it very well, and have been both more suitable and more useful for the actual quantity than for a coefficient. But "henry" has already been half appropriated to the secohm, so, for illustrative purposes at any rate, I propose to use the name "weber" for the unit magnetic flux.

Concerning the most convenient size for the weber, there is much to be said for making it 10^8 C. G. S. lines, though that is bigger than ordinarily occurs in practice; because then a wire which cuts one weber per second will have a volt difference of potential between its ends. Or a coil of 20 turns through which the magnetic induction changes at the rate of one weber per second will have an E. M. F. of 20 volts induced in it. The average E. M. F. in such a coil, spinning 30 turns a second, and inclosing a maximum total induction of one weber, is 600 volts.

This is the dynamo use of the unit; the following is the motor use: A wire carrying an ampère and cutting a weber per second does work at unit rate, viz., one joule per second.

Probably the simplicity of all this compensates for the rather unwieldy size of the unit. A strongly magnetized piece of iron may have 20,000 lines to the square centimetre; so a weber could occur across a narrow air gap half a square metre in area. The earth gives an induction of about one weber through every 23,000 square metres of England, or 100 webers per square mile. The earth induction through a horizontal square metre is 44 micro-webers, so with micro and milli webers the range would be fairly covered, though a smaller weber would have been better if it had been equally convenient as regards the volt. The pull between two parallel surfaces joined by a weber is $10^{16}/8\pi$ dynes, or 400,000 tons. A milli-weber gives less than half a ton pull, and a micro-weber less than half a gramme.

Because of the property that the voltage excited in a circuit is equal to the webers cut by it per second, a weber might be called a sec-volt. It is equal to a secohm ampère-turn; that is to say, if a single turn of wire can have a self-induction coefficient of one secohm, it will excite a weber of induction for every ampère passing through it.

[Such a circuit in the form of an anchor ring would be enormous, something like a mile across; but it could be made in the form of a solid cylinder of best iron (μ=2,500), with an axial perforation for the wire, and 80 metres long. If a secohm coil has n turns, then an ampère passing through it excites only one-fifth of a weber, for, since every turn incloses the induction, the latter is effective n times over, and so the induction coefficient is n times the induction per ampère, or n^2 times the induction per ampère turn.]

No name is needed for intensity (or density) of induction (B), for that can always be expressed in webers per unit area. [For instance, strongly magnetized iron, with say 10,000 lines to the square centimetre, has one-tenth of a weber per square foot, or 0.7 milli-webers per square inch.] And there is a practical gain in thus leaving the specification of area open, for it enables British units of length to be employed in measuring air-gaps, yokes, cores and polepieces. So long as dynamo dimensions are commonly expressed in inches, there is no serious objection to specifying induction in fractions of a weber per square inch or per square foot.

Magnetomotive Force.

Now, consider the magnetic analogue of the volt, the unit of magnetic potential or magnetomotive force. By this is understood the line integral of the magnetizing force H, the quantity $4\pi nC$, the step of potential once through and all round the circuit of a coil. It is a quantity most important in practice, and requires a name.

Mr. Heaviside has suggested the name "gaussage," as analogous to voltage; and, if this were adopted, the unit of magnetomotive force would be the gauss. The intensity of the magnetizing force would be the gauss-gradient, or drop of gaussage per centimetre; no special name is needed for the unit of this quantity H.

The common practical unit of "gaussage" at present is the ampère-turn, and this has several advantages. It may, however, be found better to make some convenient number of ampère-turns into a gauss; for instance, the C. G. S. unit of gaussage would by 4π 110, or, 1.2566 ampère-turns. If that were adopted as the gauss, the horizontal component of the earth's magnetic intensity about here would be, say, .18 gauss per linear centimetre.

But this unit, whether the C. G. S. unit or the ampère-turn, is very small. The step of potential all round a single ampère-turn is only equivalent to a vertical step of about two centimetres in the earth's field. Nevertheless, in spite of its smallness, the ampère-turn as a practical unit of gaussage will probably commend itself by reason of its simplicity. Let us see how it works out.

Reluctance.

The ratio of gaussage to the induction excited by it is a quantity characteristic of the magnetic circuit, and called its reluctance or magnetic resistance. This is the quantity $l/A\mu$ for simple circuits, or $\Sigma l/A\mu$ for complex ones; it is unfortunately not constant for any but air circuits. This constitutes one difficulty of naming its units satisfactorily, else it might be expressed as so many "gilberts" or "sturgeons" (analogous to ohms). It is, however, fairly constant under many common conditions of practice, and it can always be expressed as gausses per weber; and, perhaps, this way is sufficient.

A magnetic circuit with unit reluctance is one that requires one gauss to induce in it one weber.

Permeability.

Permeability (μ), analogous to electric conductivity, would be measured by the webers induced through unit cube of the material between whose faces there is a unit fall of gaussage. It has been suggested (by Prof. Perry) that the permeability of air had better be called $4\pi \times 10^{-9}$. But the whole electromagnetic system of units is based on the μ for air being called 1; so it would be rather confusing to change that. Moreover, it would be a retrograde step to affix another incorrect value to the constant μ, instead of waiting and trying to find out what its value really is. It is better to adhere for the present to the existing table of permeabilities, and to use whatever constant factor may be needed in order to turn $l/\mu A$ into practical units of reluctance.

Permeance.

But the reciprocal of reluctance, or the webers induced per gauss, may be the more instructive thing to attend to and name; just as conductivity is often more directly interesting than resistance. This reciprocal ratio, $\mu A/l$, has been called "permeance," and that is not a bad name for it; it is proportional to the inductance of a single-looped circuit. Permeability is the permeance of unit cube of the material. Permeance is the webers induced per unit drop of gaussage. Permeability is the webers per unit induced by unit gauss gradient.

The permeance of the magnetic circuit inclosed by a solenoid of wire in the same as its appropriate self-induction coefficient divided by 4π times the square of its number of turns. The C. G. S. unit of permeance (or of reluctance) is that of a centimetre cube of air, and is not a bad-sized unit. But it is inconsistent with the weber as 10^8 and the gauss as a single ampère turn. One of the three must give way.

On the whole, I have no hesitation in suggesting that the derived unit (that of permeance) must give way, and be taken as $4\pi \times 10^7$ C. G. S. units, in order to harmonize with the other two, as already defined.

The fact is that the great size of the weber renders a small gauss desirable, in order that their product may not represent too large a quantity of energy. For instance if 1 C. G. S. unit were taken as the unit of permeance, the weber being fixed at 10^8, then the gauss would also be 10^{-8}, and the gauss-weber would be 10^9 joules, or nearly 300 Board of Trade units; which is far too much. Whereas if the unit of permeance is fixed high, and the gauss kept small, then the energy corresponding to a gauss-weber may be moderate. Thus with 10^8 C. G. S. as weber, and an ampère turn as gauss, their product is only $10^9/4\pi$ ergs, or $100/4\pi$, or about 8 joules; which will be useful in energy considerations connected with the heating of transformers.

I therefore propose, in order to retain the ampère turn as unit of gaussage, that the permeance of a cylinder of material of length l and area A be reckoned as $\mu A/l$ multiplied by $4\pi \times 10^7$, if dimensions of the cylinder are measured in centimetres; μ being its ordinary tabulated value with air = 1. If dimensions are measured in inches, then the permeance of a cylinder will be $\mu A/l$, multiplied by $4\pi/2.54 \times 10^7$: that is, by about $\frac{1}{2}\ 10^8$. The unit of permeance thus suggested is immensely big, and it requires a name of which easy sub-multiples could be formed. A slab of iron one centimetre thick, and with its μ = 2,500, would need an area of five square metres in order to have unit permeance; but a micro-unit would be possessed by an air gap a millimetre thick and less than a decimetre square.

PROPOSED RESOLUTIONS.

1. That the unnecessary prefix "micro" be dropped before the word farad, and that the farad be defined afresh as 10^{-15} C. G. S. electromagnetic units of capacity.

2. That the name "mo" for the unit of conductance, or the ampère per volt, be recognized and adopted. (Every *mo* in a cable enables it to carry an ampère with a drop of 1 volt.)

3. That the ampère-hour be recognized as a convenient practical unit of electrical quantity.

4. That the volt-ampère-hour be recognized as a convenient practical unit of electrical energy, and be called the watt. (It equals 2,640 foot-pounds, or a trifle over a foot-ton.)

5. That the present Board of Trade unit be called a kilowatt.

6. That the ordinary unit of power be a kilowatt per hour. (It equals about four-thirds of a horse-power, more accurately $\frac{1000}{746}$ h. p.)

7. That it is convenient to retain the name joule in its present sense of a volt coulomb, or 10,000,000 ergs, for use in the science of heat; since heat capacities are conveniently expressed in joules per degree; and it will be handy to remember that a volt-ampère generates one joule of heat per second.

8. That the name coulomb be affixed to the electrostatic unit of quantity (for academic purposes).

9. That a name be given to unit magnetic flux or total induction, and that the name weber is suitable.

10. That the most convenient size for the weber is 10^8 C. G. S. units or "lines" (since the rate of change of this through a circuit is equal to the induced voltage).

11. That a name be given to unit magnetic potential or magnetomotive force, and that the name gauss is suitable.

12. That the handiest size for the gauss is one ampère-turn.

13. That a name be given to the ratio of the weber to the gauss, or unit of permeance, or self-induction per turn of wire. [If the above resolutions were adopted, this unit would be $4\pi 10^7 \times$C. G. S. units, or $\frac{1}{4}$ secohm per turn.]

14. That intensities of field be expressed in gausses per unit length, and densities of induction in webers per unit area (leaving the length or area unit open for practical convenience to arrange).

No doubt many of these recommendations have been made before. Mr Preece has often urged the change of farad, so that I hope there will be no difficulty about that. I find that my magnetic suggestions are very similar to those suggested by Prof. Perry in his modified letter to the Committee, as published in *The Electrician*, Vol. XXVII., p. 355 (July 31, 1891), and received there with approving editorial comments. The accordance between our suggestions is satisfactory, and makes it likely that they are such as engineers may be satisfied with and be willing to adopt. I need hardly say that I lay no stress upon the particular names here proposed. In choosing them I have been influenced by such trivial considerations as the selection of a monosyllable to correspond with volt, and a dissyllable to correspond with ampère or coulomb.

[With regard to Prof. Perry's footnote concerning college instruction and use of C. G. S. units, I suppose systems of teaching differ; but a senior student ought to be taught to deal with concrete quantities in so familiar a manner that no possible admixture of units can be any puzzle to him, nor involve anything worse than a little tiresome arithmetic.]

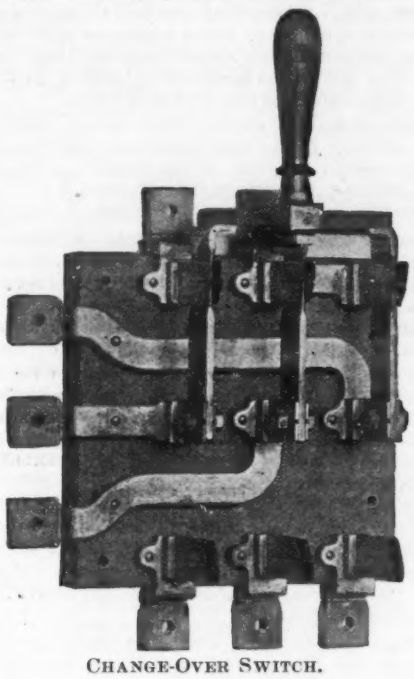
MECHANICAL UNITS.

There are several quantities in dynamics beside the joule and the watt for which brief names would be advantageous. I do not propose to discuss these fully now; but the present opportunity might be utilized by agreeing to at least one unit, that of pressure, viz., the "atmosphere," which might be defined as 10^8 C. G. S., or dynes per square centimetre, and stated to be equal to the pressure of a column of mercury 75 centimetres high at a specified temperature. The inconvenient pressure 76 centimetres might be spoken of as a Regnault atmosphere. I believe that a smaller unit of pressure, for instance, the micro-atmosphere or "barad," might also be usefully named. These pressure units will be useful for expressing energies per unit volume also, and the "barad," or whatever other name is decided on for the erg per cubic centimetre, is of reasonable magnitude for many purposes.

A New Change-Over Switch.

To meet a demand created by the increasing application of electricity for lighting purposes, the switch shown in the cut has been devised by the General Electric Company. This is constructed for use as a main switch on installations using independent or isolated dynamos, and at the same time connected with the street service.

The switch is mounted upon a slate base. Three connecting wires are arranged crosswise between the two sets of side contact clips. To these bars are hinged three switch blades, having a common handle, which can be thrown into either set of contact clips. Two of the clips on one side are connected together, and it is on this side that connection is made with the main wires of the isolated plant, which must be wired according to the three-wire system. It is necessary that the neutral wire which is brought to the central connecting bar of the switch should be of larger sectional area than usual. When the lights are being run from their own isolated plant the neutral wire acts as the



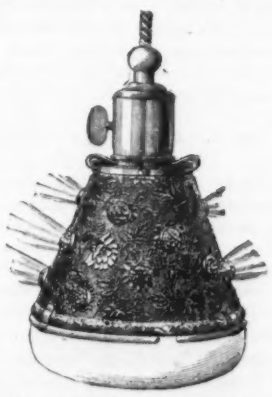
CHANGE-OVER SWITCH.

positive conductor, the two outside wires serving as the negative. Thus, when the isolated plant is shut down, and the street service thrown on, the building is lighted on a true three-wire system.

The advantageous uses to which this switch can be put are numerous. In factories having isolated electric plants, the operation of the boilers, engines and dynamos after whistle blow, when part of the force is working overtime, would be extremely costly. Connection with the street service is therefore made, the switch illustrated thrown over from the isolated service and the factor lighted on an economical basis. The switch can also be used as an emergency or break down switch in case of injury to the isolated plant. In theatres and other public institutions, where a sudden extinction of light would inevitably cause a panic, it is a moment's work only to switch on the current from the street and avert disaster.

The Paradox Reflector Shades.

The advantages of a reflecting shade are well known, and the form shown in the accompanying illustration possesses many good features. By the use of this combined reflecting and diffusing shade the light is wholly utilized, and so directed and diffused that the resulting illumination is greatly superior to that given by the ordinary unprotected incandescent lamp. The light is softened, and that disagreeable glare is entirely avoided. These shades are made in two parts, so that they can easily be taken apart and cleaned,



THE PARADOX SHADE.

the upper being half of metal with a reflecting surface of highly polished, nickel-plated tin, corrugated so as to best distribute the light and the lower half a ground or etched glass bowl made with a rim, which fits into suitable locking clamps attached to the upper half. This construction gives strength, durability and lightness. These shades are made with plain corrugated reflectors or in more artistic designs, such as that shown in the cut. They are manufactured by the F. Holman Electrical Company, 128 Pearl street, New York.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

NEW YORK AND BOSTON, Aug. 27, 1892.

Boston Financial Review.—The upward movement and general strength in the market still defies the frequent onslaughts of the bears, and there are a very few exceptions in the list which have in any degree weakened under their attacks, and these are the railroad stocks. The industrials continue strong, and are climbing up every day to higher figures. There is considerable work done among the brokers in forming pools for the purchase of different stocks in a large way, and this will naturally lead to broadening the market. London has not been a large factor in our market for some time, and its trading is not particularly on one side or the other. Another export of gold was made this week without any apparent influence on the market. The money market has been slightly easier during the week. Those banks who have been endeavoring to keep rates up have not succeeded so well as they would by waiting a few weeks, as the natural stringency in the market coming with the autumn will of itself raise the rate. The rate at the Clearing House fell off to 3 per cent. Considerable call money is offered at 3½ per cent. Good paper brings from 4½ to 5½ per cent.

The Electrical Stocks in Boston have experienced no reaction as yet, and continue in their unwavering strength, with no other fluctuation than a rise. Westinghouse stock has been the leading feature among the electrics, and, in fact, some days was the leading feature of the entire market. It has steadily risen without let or hindrance. The common stock has approached the price formerly held by the preferred stock, having reached 40. The preferred stock has risen as well and is now at a premium above par, having reached its highest price, 53. A large amount of common stock has been traded in, and the buying has been from strong parties. It is not apparent that much Pittsburgh stock has come on to the market, for attempts made by Eastern parties to get hold of it have met with little or no success. It does not appear what the actual incentive may be for the unusual rise in this stock, but it is, no doubt, in furtherance of some plan which will soon be made known, and give the company more strength than ever. General Electric stock has been very quiet. Throughout the week it has been strong at about 117½, and therefore suffers little fluctuation, but for the time being, at least, the traders have let it alone. The 5 per cent. debenture bonds have been sold up to 104¼, gaining somewhat fractionally with every sale. Bell Telephone reached 207, that by sale of a very small lot, too small, in fact, to establish the real market on the stock. Each sale shows good strength in Fort Wayne, and the Series A and Detroit Electric also maintained a good price. The continued strength in the Westinghouse stocks throughout the week has given rise to new rumors of consolidation with the General Electric Company. It is understood that the business for the month of August was about $750,000. The amount of preferred stock outstanding is $3,400,000, and common $6,600,000. Of this $1,200,000 is held as an asset in the treasury. The preferred stock is entitled to 7 per cent., requiring something under $240,000 for dividends; it would take therefore $700,000 only to pay 7 per cent. on the capital stock, both common and preferred. The earnings, it is asserted, conservatively can be placed at $8,000,000 gross per year, and net at $1,500,000. These figures are based on the rate of business which the company is doing now. Of course the amounts for the current calendar year will not equal the above. This amount of $1,500,000 is applicable directly to the stock dividends, as there are no bonds or debt ahead of the preferred stock. Accordingly the company appears to be earning about 15 per cent. on the entire capital stock. The company's charges and dividends are less than before the reorganization, and on the other hand its earnings are much greater, with the prospect of further increase in the near future. The old stock sold at $68 per share, par being $50; this was assessed 40 per cent., which was turned into the treasury and put out as preferred stock, being underwritten at 50, and this at the time of the Baring failure, when the financial situation was most grave. When it is considered that the price of the old stock was 68, and that 40 per cent. has been added to the value, the present figures are not so astounding.

Westinghouse Electric and Manufacturing Company.—The interest upon the scrip of the company to Sept. 1, 1892, is payable at the office, 120 Broadway, New York, to holders of record on that date. The scrip books close from Aug. 27 to Sept. 2.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Aug. 27, 1892, and the range for the week in Boston and Chicago:

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	8¾	....	8¾	9
Thomson-Houston Elec.—Series D	sh	120,000	8¼	....	8¼	8½
Thomson Elec. Weld	100	1,000,000	....	....	....	....
Thomson European Elec. Weld	100	1,500,000	10¼	....	10	12
Westinghouse Elec.—New Com.	..	6,000,000	40	32½	38⅜	39
Westinghouse Elec.—Pfd.	..	4,000,000	53	49½	51	51½
General Electric	..	30,067,200	118½	116	116	116½
" " Pfd	...	4,136,300	119¾	119	119	119¾
Fort Wayne Elec.	25	4,000,000	13	....	12¾	13
Fort Wayne Elec.—Ser. A.	sh	80,000	8	....	8	....
Detroit Elec.	10	750,000	7	....	7	....
West End St. Ry. Co.—Com	50	7,150,000	74	73	73	73½
West End St. Ry. Co.—Pfd	50	6,400,000	88¾	87½	87¾	88
American Bell Tel	100	15,000,000	207	205	205	206
Erie Tel. & Tel. Co.	..	4,800,000	45½	45	45	45¼
Mexican Tel. Co.	10	1,280,000	1.10	....	1.10	1.15
New Eng. Tel. & Tel. Co.	..	10,304,600	57	....	56½	....
Tropical Tel. Co.	10	400,000	....	....	....	20c.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.
Chicago	216½	..
Central Union	57½	60
Iowa Union	20	25
Michigan	90	95
Missouri & Kansas	56	60

Electrical Stocks:	Bid.	Ask'd.
Chicago Arc Light & Power Co	101	102½
Chicago Edison Co. exrights	135	..

NEW INCORPORATIONS.

The North Shore Contracting Company, of Chicago, Ill., capital stock $50,000, has been formed to build electric light plants, etc. Edward F. Wyman, Julian E. Buckbee and Francis DePfuhl are the incorporators.

Albia Electric Light and Power Company, of Albia, Ia., capital stock $30,000, has been started to own and operate electric light and power plants. S. R. Jackson, Max Loeb and Tom D. Lockman, all of Albia, are the parties interested.

The Fort Wayne Electric Railway Company, of Fort Wayne, Ind., capital stock $1,000,000, has been formed to own, construct, maintain and operate a street railway in Fort Wayne and South Wayne. John H. Bass, S. B. Bend and Andrew Squire are the organizers.

The Hopatcong Hotel Company, of Mount Arlington, N. J., capital stock $135,000, has been formad to construct and operate electric light works, etc. J. T. Rossell, Brooklyn; W. C. Culver, Jersey City, and H. M. F Randolph, of New York City, are the organizers

The C. E. Hunger Company, Cleveland, O., capital stock $25,000, has been formed to manufacture and deal in electrical and other mechanical devices, etc. C. E. Hunger, Edward Draudt, Albert Dranett, Gottlieb Scheidegger and Fred N. Huge are the incorporators.

The New York Visual Telegraph Company, of Elizabeth, N. J., capital stock $100,000, has been formed to transmit news, etc., by means of electrical devices. W. W. Rider, New York City; A. Blackburn, Yonkers, N. Y., and J. E. Brown, of Elizabeth, N. J, are the promoters.

The Everett Electric Brick Company, of Everett, Wash., capital stock $20,000, has been formed for the purpose of generating electricity for light and power, etc. C. G. Slayton, Melvin Swartent, Wm. F. Browns, Robert Niedergeaess and F. O. Coe, of Everett, are the incorporators.

The Northwestern Electric Light and Power Company, of Chicago, Ill., capital stock $25,000, has been formed to operate electric light and power plants, and to supply and furnish light and power. Geo. W. Bryson, Francis M. Charlton and Percy L. Shuman are the promoters.

The Canadian Whitney-Hoyt Electrical Instrument Company, of Manchester, N. H., capital stock $330,000, has been formed to manufacture and sell electrical instruments. E. R. Whitney, A. H. Hoyt, F. F. Dunlap, John F. Chase and Jennie M. Dunlap are the incorporators.

The Fairmount Park and Haddinton Passenger Railway Company, of Philadelphia, Pa., capital stock $50,000, has been formed to construct and operate an electric street railway in Philadelphia. James Jarden, Jr., Charles F. Trego and Adolph Hermann are the incorporators.

The Mansfield Electric Company, of Mansfield, O., capital stock $50,000, has been formed to manufacture and sell electrical supplies for street railway and electric lighting purposes. Reid Carpenter, F. B. Black, Moses Black, L. P. Bennett, and E. F. Cooke are the parties interested.

The Sperry Electric Railway Company, of Cleveland O., has been incorporated with a capital of $250,000 for the purpose of manufacturing electrical supplies, etc. The incorporators are James Parmelee, Webb C. Hayes, Jas. Hoyt, Washington H. Laurence and Myron T. Herrick.

The Northwest General Electric Company, of Boise City, Idaho, capital stock $1,750,000, has been formed to construct, sell, purchase or lease electric plants and other appliances. T. C. Sullivan, H. W. Turner, C. A. Daigh, P. F. Meek, Jr.; W. G. DeCelle St. Paul, Minn., are the incorporators.

The Sonora Electric Light Company, of San Francisco, Cal., capital stock $10,900, has been formed to manufacture, construct, maintain and operate systems of conductors for the distribution of light and power. Jas. Armstrong, Wm. V. Lockwood, J. H. Harbourne, of San Francisco, and C. S. Fitch and P. M. Keeffe, of Sonora, Cal., are those interested.

Campania de Tranvias Electricas de Monterey, Mexico, of Jersey City, N. J., capital stock $1,000,000, has been formed to construct and operate electric railways, etc. A. E Crocker, Monterey, Mex.; C. B. Walker, of New York, N. Y., and G. B. Vanderbilt, of Princeton, N. J., are the incorporators.

People's Electric Light and Power Company, of Jersey City, N. J., capital stock $1,000,000, has been formed to manufacture, use and distribute electricity for electric lighting, etc. F. Z. Maguire, of New York City, F. A. Magowan, of Trenton, N J., and W. C. Heppenheimer of Jersey City, N. J., are the incorporators.

The Union Railway and Electric Company, of Everett, Wash., has been incorporated with a capital stock of $200,000 to manufacture, produce and sell electricity, steam, gas, compressed air, etc.; to furnish railways and deal in railway equipments. J. B. Hawley, Schuyler Durgee, Geo. S. Brown, of Everett, Wash., are the incorporators.

The Spanish American Light and Power Company, of Jersey City, N. J., capital stock $1,000,000, has been formed to manufacture and sell electricity for light, heat and power. W. S. Johnston, New York; H. G. Runkle, Plainfield, N. J.; R. A. G. Smith, J. F. Gibbons, New York, and G. Holmes, of Jersey City, are the incorporators.

The Consolidated Street Railway and Light Company, of Salina, Kan., capital stock $100,000, has been formed to construct, maintain and operate an electric railway in Salina, Kan. C. L. Baum, of Salina, Kan.; Eli H. Chandler, Chas. French, of Kansas City, Kan.; Alex. Simes and H. L. Chandler, of Philadelphia, Pa., are the incorporators.

The Commandoer Water Power Electric Company, of Milwaukee, Wis., has been incorporated with a capital stock of $10,000 to purchase and control certain U. S. patents issued Nov. 11, 1890, and July 21, 1891, known as wave power. H. Commandoer, C. Gens, W. Elert, W. Arndt and G. P. Buez are the promoters.

The Leavenworth Electric Transit Company, of Leavenworth, Kan., has been formed with a capital stock of $500,000, to buy, lease or otherwise, lines of railway, and to operate the same in Leavenworth, Kan. The incorporators are C. F. Brotherton, L. M. Erb, of Kansas City, Kan.; S. T. Neely, C. S. Hartough and Wm. C. Hook, of Leavenworth, Kan.

The Ice, Light and Water Company, of Marble Falls, Tex., capital stock $75,000, has been incorporated to supply water to the public, to manufacture and supply electricity for all purposes and to manufacture and supply ice to the public. B. Badger, A. R. Johnson, Leonard Isaacs, O. J. Gorman, T. E. Hammond and J. B. Pankey are the promoters.

The Harrington Townsite Company, of Spokane, Wash., capital stock $50,000, has been formed to buy, own, sell, lease and improve real estate at Harrington, Wash., to construct and operate water works, gas and electric light plants, telegraph and telephone lines, warehouses and elevators, etc. David Wilson, of Tacoma; Horace L. Cutter and F. Rockwood Moore, of Spokane, Wash., are the promoters.

The Municipal Engineering and Construction Company, of Orange, Conn., capital stock $3,000, has been incorporated to build, equip, develop, own and operate all kinds of works of internal improvements, public or private, water, gas or electrical, railways, bridges, etc. Edward H. Phipps, New Haven, Conn.; H. Hungerford, West Haven, Conn., and Chas. M. Berrian, New York City, are the incorporators.

The Paterson and Little Falls Electric Railway Company, N. J., capital stock $50,000, has been formed to construct, maintain and operate a street railway for the public use. T. M.

Ryle, J. R. Lee, J. A. Morrise, A. H. Post, F. C. Van Dyk, S. Nathan, A. A. Van Voorhies, D. Henry, W. Pennington, M. Clarke, J Agnew, Paterson, N. J.; C. Peck, Newark, N. J., and W. D. Ramseys Ramseys, N. J , are the promoters.

The Acme Storage Battery and Manufacturing Company, of Jersey City, N. J., has been incorporated with a capital stock of $5,000,000. The incorporators are George C. Warner, C. T. Griffiths and William L. Baker, of New York; Jacob Herbert Potts, of Jersey City, and W. M. McDougall, of Orange. The object of the company is to purchase and deal in storage batteries and generators and erect a plant to carry on the business.

The Oak Cliff Water, Light and Power Company, of Oak Cliff, Tex., has been formed with a capital stock of $100,000 to supply water to the town and light and power by means of electricity. J. C. Muse, W. J. Batterton, W. I. Addison, W. L. Diamond, Geo. W. David, M. J. Dart, H. F. Ewine, E. G. Patton, T. L. Marsalis, A. T. Watts, W. H. Patterson, Jno. N. Wharton, G. W Owens, W. M. Miller are the incorporators.

AFFAIRS OF THE COMPANIES.

The Hartman General Electric Company, of Duluth, Minn., in accordance with a recent amendment to its charter, has filed notice of the issue of $138,000 worth of the $500,000 trust deeds.

The Beacon Light Company, of Seattle, Wash., capital stock, $100,000, has been started to engage in electric light and other business. Fred. E. Sander and G. E. M. Pratt, both of Seattle, are interested.

The Gonzales (Tex.) Electric Light and Power Company has been organized and the following officers elected: W. S. Fly, president; T. F. Harwood, vice-president; G. N Dilworth, treasurer, and R. H. Walker, secretary. It will be chartered for $20,000, and power will be furnished by T. S. Walker's dam.

The Ypsilanti Electric Light Company has perfected its reorganization with additional stockholders and increased capital by electing the following officers: N. B. Perkins, president; O. E. Thompson, vice-president; A. C. Rorison, secretary; W. H. Sweet, treasurer. It is the purpose of the new company at once to erect a fine brick building 58 by 37½ ft., with an additional boiler room 22 by 28 feet. It will fit up these buildings with two engines of large power, two boilers and three dynamos, two of which will be used for incandescent and one for arc lighting.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Aug. 29, 1892.

Mr. C. A. Coffin president of the General Electric Company sailed for Europe on Thursday of last week.

Henry Hine, General Manager of the Stanley Electric, of Pittsfield, Mass., was in the city last week. The Stanley company is enjoying a prosperous, steady growth, and will shortly bring out several novelties.

The Helios Company, of Cologne, Germany, has recently bought Mr. Nikola Tesla's patents for alternating generators, motors and like apparatus, both for two wire and for three wire systems. Mr. Max Luhn, electrical engineer of the Helios Co., has just come over to America to study the construction and application of these motors. Mr. Luhn also intends while here to visit some of the best electric light and power plants in this country.

L. H. H.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Aug. 27, 1892.

The Hall Signal Company has opened a New England office in the Ames Building, Washington street, Boston, and will hereafter be well represented in that territory by C. W. Brewster, general sales agent.

A. Otis Smith, formerly treasurer of the Eastern Electrical Supply Company, and J. Edward Wallace, the efficient general sales agent, formerly connected with the same company, have formed a copartnership under the firm name of Smith & Wallace, and opened offices at 8 Oliver street, Boston, where they are prepared to furnish all supplies needed in the equipping and running of electric railways. Both of the gentlemen are well known to the trade and will, no doubt, meet with excellent success in their new enterprise.

W. R. W.

WESTERN NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
465 THE ROOKERY, CHICAGO, Aug. 27, 1892.

Mr. C. C. Haskins, of Chicago, will deliver a lecture on "Electricity, Light and Fire," before the underwriters' meeting in Chicago early in September.

Madison, Wis.—The Thomson-Houston company has about completed the purchase of the local electric light plant, and is now putting in an electric street railway.

Marquette, Mich.—An electric road 13 miles in length will be built to connect the city of Marquette with the city of Negaunee. Contracts have not yet been let for the machinery.

Mr. Frank S. Gorton, secretary of the Chicago Edison Company, denies that there will be a combination of the Chicago Edison Company and the Chicago Arc Light and Power Company's interests.

The Central Electric Company reports that the ten story Dakota building in this city is to be wired throughout with okonite. Interior conduit will also be used. It also reports having secured an order for some ten miles of No. 6 Acme lead covered cable tested for 5,000 volt circuit.

Visitors.—Among the out of town visitors in Chicago this week from St. Louis were Mr. S G. Booker, manager of the Fidelity Carbon Manufacturing Company; Mr. J. H. Rhotehamel, president and general manager of the Columbia Incandescent Lamp Company, and Mr. O. W. Garrison, the St. Louis representative of the Illinois Steel Company, and who is also interested in the Columbia Incandescent Lamp Company.

F. DE L.

TACOMA, Wash., Aug. 22.

The Point Defiance, Tacoma & Edison Railway Company is now operated entirely by electricity. The 13 miles of overhead constructions was recently completed and turned over to the company by the Northwest General Electric Company. The Northwest Thomson-Houston Company received the contract originally. F. L. Dame, superintendent of construction, was in charge of the work.

The Seattle Consolidated Street Railway Company held an election recently to fill the two positions left vacant by the resignation of L. H. Griffith, who is expected to resume them again after he has completed the reorganization of the Tacoma street railway lines. Dr. E. C. Kilbourne was elected president and J. E. Porter general manager. R. R. Spencer was elected treasurer, to succeed E. C. Kilbourne.

The Tacoma Railway and Motor Company has ordered two 175-kilowatt Edison railway generators, which have been shipped and are expected to be running Sept. 1. Ten double 15 h. p. and ten double 25-h. p. car equipments of the Thomson-Houston type recently arrived. Three thousand feet of new line on Starr street recently went into operation. A new scale of wages was adopted Aug. 1, conductors and motormen receiving 3c. per mile being supposed to make $75 a month.

The Rainer Power and Railway Company has laid its tracks from the terminus of the original line at Lake avenue on Lake Union, along Almy, Elaine, Lincoln, Stewart, Ninth, Pike and Eighth to Union street, and the rails are now being laid on Union street from Eighth to Third. The road will probably be completed to Yesler avenue Sept 1. The Ravenna Park extension is approaching completion and the line will be ready for operation as soon as the crossing over the Lake Shore road is laid.

The Seattle Gas, Electric Light and Motor Company has sold all of its stock to a syndicate composed of Seattle and St. Paul capitalists for $630,000. Lester Turner, of Seattle, representing the purchasers, stated that the control of the organization would remain in Seattle. The principal stockholders of the company before the sale were John Collins, Dexter Horton and A. A. Denny. A few arc lights were operated by the company and no motors, the gas business being the most important interest.

The Seattle-Tacoma Electric Railway Line.—Fred E. Sander, president of the Grand Street Electric Railway Company, of Seattle, has long been working up the project of building south from Seattle to meet half way a similar line to be built north from Tacoma. He has applied for a franchise for a double track electric railway from Riverside Park on the Grant street line along the county road to Braun's brewery. Thence he will follow the shortest possible route to Tacoma, running through private property on easy grades. Both freight and passengers will be transported.

G. R. DE V.

CANADIAN NOTES.

OTTAWA, Aug. 20, 1892.

Kingston, Ont.—The Royal Military College will be lit by electricity, furnished by the Kingston Heat, Light and Power Company.

Newmarket, Ont.—The Light, Heat and Power Company has been incorporated with a capital stock of $40,000 to make and supply electric, steam and water power.

Montreal.—The Packard Lamp Company has been incorporated at Montreal with a capital stock of $8,000 to manufacture electric lamps and electric machinery generally.

Patterson & Corbin, street car builders, are pushed with work, manufacturing horse and electric cars for Yarmouth, N. S. Winnipeg, Man.; Sarnia, Ont., and Toronto Junction.

Winnipeg—Tenders are invited for the building of a brick addition to the present power house of the North West Electric Company, Ltd., including the putting in of two steam boilers.

Victoria, B. C.—An incendiary fire on Aug. 7 completely destroyed the whole plant of the National Tramway and Electric Light Company, with a total loss of $200,000. The insurance does not exceed $50,000.

Montreal.—The Merchants' Telephone Company, of Montreal, has given notice that application will be made for the issuing of letters patent. The capital stock is $100,000, divided into 4,000 shares of $25 each.

St. John, N. B.—B. Mooney & Sons and E. L. Prince have been awarded the contract for the addition to the Consolidated electric light station on Union street, to accommodate the street railway power plant.

Digby, N. S.—The electric light company will shortly be taken over by John Daley and G. I. Lettney & Bro. of this place, Mr. Smith, who represents the company, having decided to dispose of the plant and business.

Peterborough, Ont.—The Brooks Manufacturing Company, Peterborough, Ont., manufacturer of electric carbons, etc., will change its corporate name to the Canadian Carbon and Porcelain Company, of Peterborough.

Windsor, Ont.—The Edison company has purchased the plan of the Citizens Electric Light Company, in Windsor, and together with the Reliance company will operate the plant. It will be put in first-class condition at once.

Toronto.—A permit has been issued to the Toronto Electric Light Company for the erection of a brick boiler house, a wooden dynamo house covered with iron and a brick office at the foot of Scott street on Esplanade, to cost $20,000.

Peterborough, Ont.—Papers have been taken out for the transfer of the interests and business of the Edison General Electric Company to a new board of managers, and for the change of name to the Canadian General Electric Company.

Hamilton, Ont.—In view of the heavy tolls collected by the owners of the several municipal roads running into Hamilton, it is suggested that the city shall build a series of electric street railways to connect the city with the suburban districts.

Rat Portage, Ont.—The Citizen's Electric Company of this town have given a contract to the National Electric Light Company, of Eau Claire, Wis., to put in the dynamos with all the latest improvements sufficient to supply 2,000 lights of 16 c. p.

Montreal.—The Canadian General Electric Light Company, with headquarters at Montreal, has been incorporated with a capital stock of $1,000,000 to manufacture machinery, apparatus and supplies of every kind connected with the use of electricity.

Halifax, N. S.—The Nova Scotia Power Company has informed the Dominion Minister of Railways that it proposes constructing an electric street railway to extend from the deep water terminus of the Intercolonial Railway along Water street to the south end.

Brantford, Ont.—Seven tenders have been received for lighting the city with electricity. The City Council has not yet awarded the contract, holding it in abeyance until it has had time to consider the question of the Council running it on the city's account.

Montreal.—The report of the sub-committee recommending the granting of the request of the Royal Electric Company to lay rails for an electric street railway on Queen, Prince and Ottawa streets so as to enable them to connect their works and test electric cars has been approved.

Rat Portage.—The Rat Portage & Keewatin Electric Street Railway Company has been incorporated with a capital stock of $300,000, to build and operate a street railway in these towns, and to engage in the supplying of electric energy for the purpose of producing light, heat and power.

Canada. The Toronto *Globe* says that within a year the horse car lines of Winnipeg, Hamilton, Toronto, Montreal and Ottawa will be largely wiped out. In Hamilton the cars are already propelled exclusively by electricity. In Toronto alone 1,500 horses will be dispensed with within a short time.

Montreal.—The Royal Electric Light Company has entered suit against the Harbor Commissioners, claiming $13,000 for refusing to allow them to continue the contract held by the insolvent firm of Craig & Sons, which they were entitled to, having purchased the entire assets of Craig & Sons.

Ottawa, Ont.—The Standard Electric Company of this city has received an order from Henry Morgan & Co., of Montreal, for a number of 8-lb. sad irons; 20 and 25-lb. tailor's goose irons and two 40-lb. irons for pressing carpets. These latter irons are 12 inches by 4 inches and have a handle seven feet long.

Toronto.—The Haworth Belting Company has just shipped two 36-inch and two 16-inch dynamo belts to the Kingston Electric Light Company, and has received an order for two 24-inch belts for the T. Easton Company, Toronto, and a large main driving belt for the North Toronto Electric Light Company.

Brantford, Ont.—A movement is on foot among local capitalists to get control of the water power connected with the Grand River and get up a much larger electric company than that which now exists. They will go into incandescent lighting on a more extensive scale and at the same time furnish power.

Brantford, Ont.—The electric light by-law, which passed the Council, provides for the issue of debentures to the extent of $11,000, payable within ten years of the passing of the measure. The amount required necessitates that the annual sum of $440 be raised for interest and $937.66 for sinking fund, or $1,337.66 in all.

Ottawa, Ont.—The telephone company's new exchange office on Queen street will be ready for occupation shortly. The switchboard to be used in the building is now being manufactured at the Bell Telephone Company's works at Montreal. It will be a multiple metallic board with a capacity of 1,500 subscribers and an ultimate capacity of 3,000.

St. Thomas, Ont.—Negotiations are in progress for the purchase of the St. Thomas street railway from the owner, Mr. Hendrie, of Detroit. Should the party seeking the road secure possession of it, it is his intention to extend the tracks on Wellington street in other directions and to run the cars by electricity on the storage battery system.

Montreal.—In addition to the twenty electric street cars the Montreal Electric Passenger Street Railway is constructing in its own shops, thirty have been ordered from the Grand Trunk Railway shops, twenty from the Crossen works at Cobourg, five from the St Charles company, of Belleville, and twelve from N. & A. C. Lariviere, of Montreal.

Winnipeg.—The Winnipeg Street Railway is very much pleased with the new Westinghouse electric car, which has arrived lately from Ottawa. Mr. Mullan, the electrician of the Ottawa street railway, came up to start it on its first trip, when the speed made was at the rate of 27 miles per hour. It hauled two trailers with 227 passengers on board.

Toronto.—The Toronto Street Railway earned $78,595.62 last month and has handed the city a check for $6,285, the largest amount yet with the exception of September of last year. Toronto has received $60,000 in the last 12 months as its percentage of receipts and from the mileage law of $1,600 per mile of double track, the city will realize as much more.

Montreal.—The street railway company of this city has started an all night service on the most important routes. The new electric cars have been ordered and contracts given to the Royal Electric Company for the motor cars. Every electrical establishment in Canada will send cars to keep the company going. By Nov. 1 there will be 31 miles in operation.

Ottawa, Ont.—Messrs. Ahern & Soper have just entered into a contract with the Montreal Electric Street Railway Company to supply ten car equipments, Westinghouse motors, 25 h. p. The contract will amount to about $50,000. The cars will be ordered from a United States firm. Ahern & Soper will probably supply the other electrical apparatus for the road.

Montreal.—Notice is given in the Quebec *Official Gazette* that Messrs. F. X. Moisan, L. E. Beauchamp, O. Venier, H. M. Linell, J. E. MacDougal, J. Archanbault, C. F. Beauchemin, Lucian Huot and E. Dagenais will apply to the Lieutenant Governor in Council for letters patent incorporating them under the name of the Merchants' Telephone Company, of Montreal, with a capital stock of $100,000, divided into shares of $25 each.

Windsor, Ont.—There is still a hitch in the negotiations between the electric railway and the Citizens' Lighting Company, of Windsor, over what the latter shall pay the former for power, and the citizens will be obliged to use gas until an arrangement can be made. The sheriff is not sure he can make a contract and President Clarke says that $250 is what the power is worth for August. The Edison people think that this is exorbitant.

Toronto.—Another difficulty now presents itself to the street railway people. There is a hitch in the supplying of machinery necessary for the generating of electric power to run the cars. Some time ago a contract was let to the Polsons to fit up the old sugar refinery as a power house. It was to have been provided with a 500-h. p. engine and other machinery, and all was to have been in place by Aug. 1. Aug. 1 is past and little or nothing has been done.

Ottawa, Ont.—One of the latest inventions in connection with the application of electricity to street car service is a self-lubricating gear for trolleys, invented by Mr. Mullan, in the employ of the Ottawa Electric Street Railway Co. The value of the device may be estimated by the fact that a trolley fitted with it on July 4 has been running ever since without oiling, and shows neither the effects of friction nor the necessity for lubricating beyond that which is automatically supplied.

Guelph, Ont.—The Bell Telephone Company has submitted a proposal to the City Council by which the company agrees in consideration of a lease for five years of the exclusive right to erect poles in the city of Guelph, to connect its wires with Rockland, Erin, Aberfoyle, Morriston and various outlying villages, and to allow the city to stretch its fire alarm wires over its wires and on its poles, and to give the city a first class metallic service to Toronto and other large cities. The matter has been referred to the Board of Works.

Brantford, Ont.—The Bell Telephone Company has made a proposition to the corporation of this city stating that it is willing to pay an annual rental of $400 for the use of the streets provided the city does not let that privilege to any other competing telephone company. The effort that is being made to secure the control of the electric lighting of this city by the City Council is meeting with considerable opposition. The Brantford Electric Light Company has issued a circular to taxpayers showing that the com-

pany's tender will cost the city $5,146.50 per annum, and the cost of municipal running will be $7,055.90, or $1,909.40 more. If the tender of the Brantford Lighting company is accepted at 23½ cents per night for 60 lamps, Brantford will have the cheapest electric lighting in Canada.

Toronto.—William Wainwright, assistant general manager of the Grand Trunk Railway, of Montreal; Samuel Insull, president of the Chicago Edison company; James Leggat, Montreal; Isaac Anderson, manager of the Standard Oil Company, Toronto, and Marshall Barr, Canadian manager of the Edison General Electric Company, Toronto, are applying to the Dominion government for incorporation as the National Trust and Construction Company (Limited), to manufacture rolling stock for railways. The chief place of business is to be at Toronto, and the capital stock $500,000.

Smith's Falls.—The Ward mill and water-power has been purchased by a syndicate for $10,000. The water-power, which is estimated to equal fully 300 h. p., will be used entirely for electric purposes, and machinery will be put in that will furnish running power for Messrs. Frost & Wood's large establishment, W. H. Frost's Malleable Iron Works, and leave about 150 h. p. to be distributed outside of those two establishments. It is also the intention to build an electric tramway from the Frost & Wood establishment, on which will be run flat cars for the carrying of freight from the shops to the freight shed. The trolley system will be used. From this power will also be supplied to a system of electric lighting.

Ottawa, Ont.—The endeavor to get the old street car line converted into an electrical line has resulted in a proposition from the company to the corporation to allow both lines to amalgamate under a 30 year charter, in place of the 20 year charter now owned by the electric line, and to give a 20 year charter to the Passenger Railway Company, with power to go back to their perpetual horse car charter at the expiration of that time. By this proposal both roads would cease to exist as private property at the same time, and could at once be controlled by the corporation, while in the case of the 20 year charter plan, when the electric road charter expired, it would leave a competing line in the old passenger railway, which would cause trouble.

Toronto.—Twenty new motor cars are under construction at the street railway company's shops and will be in operation early next month. The uniform length of the cars, not including the platforms, is 18 feet, or 26 feet from end to end, and 7 feet 10 inches wide, giving a wide passage of 2 feet 6 inches between the seats, which consist of steel springs upholstered with rich Brussels plush. Light and heat will be supplied by electricity. The cars are finished internally with polished hardwood, the doors and sheathings of quartered oak with cherry panels. The blinds have cherry frames, while the slats are white birch. The electric motors are from the Edison factory at Peterborough, the car wheels from St. Thomas. With these exceptions all the raw material is being worked up in Toronto.

St. John, N. B.—The winding up proceedings in the New Brunswick Electric Company case were held before Judge Tuck last week. C. J. Coster, acting for the executors of the late R. P. Starr, recently obtained an order for liquidation, and yesterday examined Dr. Foster McFarlane and Messrs Joseph Merritt and W. B. French on the state of the company. The New Brunswick and Eastern Electric companies have been amalgamated, the former trfinsferring all its assets to the consolidated company, in return for which it received $50,000 of preferred stock and $25,000 of bonds, the latter to be used to pay the creditors. In June the New Brunswick company made an assignment of the balance of the bonds in its hands to Mr. French for the benefit of its creditors. The company is now without officers.

New Westminster, B. C.—Two generators weighing 40,00 pounds each and with a capacity of 250 h. p. have been added to the already tolerably complete electric plant of the Westminster Vancouver Tramway Company. The machines are run by 30,000-pound Ideal engines and the power generated by each is sufficient to manipulate the entire traffic of the road. Besides these the company has its old generators—two in number, of 120 h. p. each. The company contemplates building the short line into Westminster in a month or so, which improvement will shorten the time between the two cities to 35 minutes. In addition to this it expects to build, and have in running order, within the next month, a branch road running from Columbia street, Westminster, to Sapperton. On Aug. 1 J. G. Brill & Co., Philadelphia, shipped four new cars, three large omnibus coaches and baggage coach to this company.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Aug. 17, 1892.

Chicago Exhibition.—Owing to the painfully inadequate show, which the English elecrical trade seemed likely to make at the Chicago exhibition, Mr. W. H. Preece was moved at a recent meeting of the Electrical Trade Section of the London Chamber of Commerce to suggest that the trade should combine to send a worthy and comprehensively representative exhibit to Chicago. The idea met with general approval at the time, but I now hear that not a single favorable reply was received to the circular which was sent out embodying Mr. Preece's suggestion.

The Proposed National Physical Laboratory.—The discussion on the proposed National Physical Laboratory, at the British Association, was opened with an admirable speech by Dr. Lodge, who remarked that, although the scientific amateur was all very well for exploring new territory, he was out of place when heavily armed troops were necessary, as was the case as soon as any branch of science had passed out of the infant stage. The tendency in this country, he said, was to keep England's leading men of science too much in the ranks, overwhelming them with laborious detail work, which could be better done by others. Our foremost men could only indulge in research in the intervals of teaching and examining. Dr. Lodge pointed out that a national institution, such as he advocated for physical science, already existed in the case of astronomy, biology and geology.

Postal Telegraph Service.—The Postmaster-General's, thirty-eighth annual report, which has just been issued, contains as usual, some interesting features relating to the telegraph service of the United Kingdom. During the financial year 1891-92 over 57,000,000 ordinary inland telegrams were transmitted; an increase of nearly 6 per cent. on the numbers for the previous twelve months. The annual value of each telegram dispatched has, however, come down from 7.87 to 7.77d., the total receipts from inland telegrams for 1891-92 being £1,848,974. The total number of telegrams, of all sorts, which were dispatched last year amounted to nearly 70,000,000, and brought in two and a quarter millions sterling, taking telegrams of all sorts, the increase for the past year is only about 5 per cent. The receipts from the London-Paris Telephone for the first year of its existence have amounted to £1,616, and the number of conversations in April last was nearly double the number which took place in April, 1891.

Municipal Electric Lighting.—The accounts for the first quarter's working (October, November, December, 1891,) of the Brighton Municipal Station were recently presented to the Town Council. In view of the various rumors current as to the mismanagement of this concern, the figures now presented are comparatively satisfactory. The first quarter's working shows a profit of £250, which is, however, swept away and converted into a deficit of £283, owing to the necessity (imposed by the legislature) of allowing large sums for interest and redemption of capital. The progress of the large central station at Bristol has been delayed owing to a bricklayers' strike, and it is not now anticipated that the supply of electricity will be available this winter. The Wolverhampton Town Council has decided to expend some £37,000 on an electric lighting station. Oldham Town Council has applied for permission to raise £40,000 for the same purpose. The Town Councils of Blackburn and Southport are respectively contemplating expenditures of £50,000 and £28,000 with the same object. A large number of municipalities have also decided to obtain electric lighting provisional orders.

The "Brain" Covered Conduit System.—The continued hostility of the local authorities of this country and of the public generally to the overhead trolley system of electric traction causes our inventive spirits on this side of the Atlantic to persist in their efforts to devise a satisfactory closed conduit system. The latest solution of this problem is due to Mr. Brain, who employs an ordinary rectangular cast iron trough with a central circular copper conductor, the top of the conduit being, as usual, level with the road sets. The novelty of Mr. Brain's invention consists in employing a wider slot than is usual, and covering it with a strong flat, flexible strip of metal resting upon ledges on either side of the slot. This rail firmly bridges the opening, sinking upon it like a lid, and is capable of carrying a weight of many tons at any point. Under each car Mr. Brain proposes to place an arrangement of flanged rollers running on the ledges at the top of the conduit and lifting up the metallic strip as they go along high enough to allow a current collector to run along the conduit. As the car is propelled along the road the collector rollers raise the cover rail, the rail returning to its seat as the rollers pass away. At a little distance before and behind the collector suitable rollers are placed, which run upon the top of the "cover rail" and press it back into its place.

The New Telephone Company.—The irritation of the public at being befooled in the manner in which they have been by the New Telephone Company has found adequate expression in the columns of the leading financial paper, the *Economist*, which writes as follows: "The promoters of the New Telephone Company, who during the past week invited subscriptions for £488,000, part of an authorized capital of £750,000, have displayed a considerable amount of prudent forethought in securing the services of Messrs. N. M. Rothschild & Sons as their issuing agents, for although the new departures made by that firm in recent years have sometimes seemed to old-fashioned people somewhat venturesome, the reputation of the great financial establishment still stands high among the investing classes of the country. We cannot believe, however, that their reputation will be enhanced by their connection with this telephone company; the fact that the National Telephone Company is to subscribe for one-third of the capital of the new company, and has nominated half of the board of the undertaking, including its own president and vice-president, is made the most of in the prospectus, but the arrangement does not seem to us an advantageous one to the new company, to say nothing of the requirements of the public. It is desirable of course that the interchange of means of communication shall be made as perfect as possible, but the close connection between the two companies is obviously intended to stifle competition and thus prevent such a lowering of the charges as the public have a right to expect, seeing that the companies are to have a sort of copartnership with the post office. It is indisputable that the telephone service forms part and parcel of the telegraph monopoly owned by the state, and those who are responsible to the public would perform their duties in a very lax manner if they permitted the exaction of charges, which must inevitably retard the development of the telephone industry, and thus render the government portion of the business less remunerative than it should be."

News of the Week.

THE TELEPHONE.

The New England Telephone and Telegraph Company, of Boston, is extending its underground system on the Beacon street line about one-half mile from West Chester Park to the junction of Commonwealth avenue and Beacon street, and will remove the poles now used there.

Bell Telephone Output.—The Bell Telephone Company makes the following report of instruments for the month ending Aug. 20:

	1892.	1891.	Inc.
Gross output	7,316	5,773	1,543
Returned	5,806	4,309	1,497
Net	1,510	1,464	46
From Dec. 20, 1891, to Aug. 20, 1892:			
Gross	65,219	47,766	17,453
Returned	37,482	27,708	9,774
Net	27,737	20,058	7,679

THE ELECTRIC LIGHT.

Graceville, Minn., is anxious to have an electric light plant.

Williamstown, Ky., is to have an electric light plant in the near future.

Henniker, N. H., is making an effort to organize an electric light company.

Clinton, Mich., is to hold a special election to decide upon the electric light question.

Detroit, Mich., has the subject of a municipal electric light plant under consideration.

Hampton, Ia., is taking active steps in the electric light question, and will soon have a plant.

Mattoon, Ill., has decided to adopt the Standard single carbon system, and is seeking bids on 100 arc lights.

Longmont, Colo.—Mr. F. P. Arbuckle has sold the Electric Light and Power Company to a syndicate of Longmont people for $20,000.

Kokomo, Ind., has awarded the contract for lighting its streets for five years to the Western Electrical Company for $87.50 per lamp.

Paw Paw, Mich., has declared that the electric light company has violated its contract, and the lights will be discontinued and poles and wires removed.

Tucson, A. T.—The City Council has adopted a resolution to enter into a two-years' contract for the electric lighting of the city with the person who would first erect a plant in Tucson.

Henry, Ill.—The electric light contract between the city and Mr. Kilpatrick is understood to be broken, and the City Council is about to enter into a new contract with the General Electric Company.

East Greenwich, R. I., has just made a five years' contract for lighting its streets by electricity. The lights are to be 1,200 candle power, to be lighted every night in the year until 12:30 o'clock. The sum to be paid is $2,500 per year, or $71.54 per light.

The Fort Dodge Gas, Electric Light and Power Company has been granted an injunction against the city restraining it from cutting down their poles on Market street. In pursuance of an order from the City Council they had been given thirty days to take their poles from the street.

C. F. Sugg, president of the Huntsville (Ala.) Electric Light and Power Company, has closed a contract with the Westinghouse Electric and Manufacturing Company, through its agent, J. R. Gordon, of the Charlotte, N. C., office, for one 1,000 light alternating incandescent dynamo and fixtures.

Rockville, Conn.—The city continues without any electric street lights on account of the increase in price by the local company to $80 a light a year. It is expected that a city meeting will be called soon to consider the matter. It is understood that the Westinghouse electric company would put in a plant for the city, to furnish 90 arc lamps and 500 incandescent lights, for about $21,000. It is estimated that the city could run the plant so that the lights would not cost over $65 a year each. The local company asserts, however, that at the old price of $75 a light it was unable to pay its running expenses and it has paid no dividend for two years, besides using part of the surplus.

THE ELECTRIC RAILWAY.

Marshalltown, Ia.—Work on the roadbed for the electric street railway has been commenced on Third street.

Muncie, Ind.—An electric street railway company has been organized here and a franchise granted, with a capital stock of $250,000, with Ohio and Indiana capital. Muncie already has one electric road.

The Electric Railroad Company, which last spring received a franchise from the cities of Yonkers and Mount Vernon, now proposes to carry its line through Pelham Manor to the Athletic Club at Travers Island, and thence to Glen Island, to connect with the New Rochelle Horse Car Railway at New Rochelle.

West Brighton, N. Y.—There is every prospect that electricity will be introduced as a motive power on the Midland Railroad this fall, and application has already been made to the State Railway Commissioners for permission to make the change and plans and specifications for the entire rebuilding of the road are being prepared by New York contractors.

The Bridgeport Horse Railway Company has been purchased by Charles A. Hotchkiss, of that city. In the fall of 1890 the stock of the company was purchased by what was known as the Rochester syndicate. They intended to introduce electricity, but the dead lock in the Legislature prevented an amendment to the charter of the company and no change has been made.

The Aurora & Chicago Interurban Railway Company has been given a franchise to build and operate its lines in Aurora. This practically completes the right of way between Aurora and Chicago. The company expects to build an elevated electric road between the cities to cover the distance in less than half an hour. The projectors hope to have the line completed by December, 1893.

To Extend Lynn's Street Railway System.—It is stated that all holders of stock in the Lynn Belt Line Company, who have not yet disposed of their holdings, have accepted the offer of $110 per share, made by the syndicate of caditalists which recently secured control of that road and the Lynn & Boston Railroad. The Belt Line will soon be extended to Salem via floating bridge and the old Boston turnpike; also to Woburn via Saugus and Wakefield.

Norwalk, O., will soon be connected by an electric street railroad with Milan, Huron and Sandusky, the proposed electric line to be constructed and operated by the Sandusky, Milan & Huron Electric Railroad Company, of Sandusky, O. It will run from Sandusky to Milan and four miles beyond to Norwalk, with a spur to Huron, starting from the Milan line either at Bogart, five miles south of Sandusky, or at Middle Huron road, just beyond the soldiers' home. The total length of the line will be 21 miles.

Louisville, Ky.—The proposed change of motive power on the Kentucky and Indiana bridge for the accommodation of Daisy line suburban trains is one of considerable importance to the people of New Albany and Louisville. The idea of the Daisy line management is to abandon steam cars and to run electric cars from the west end of New Albany and from Vincennes street to Louisville without change. If the change is accomplished trips between this city and New Albany will be made more frequently. The cost of the proposed change will be about $80,000.

LEGAL NOTES.

Worthless Patents Are Not Payment for Stock.—Under the Corporation act of New Jersey, providing that nothing but money shall be considered payment of stock, except that directors may buy necessary property, and to the amount of the value thereof issue full-paid stock, marked "Issued for property purchased," the directors of a corporation, the incorporators of which have agreed to give 60 per cent. of the stock to a person for two patents, are justified in refusing to issue such stock when one patent has not been perfected and the articles made under the other are worthless. This decision was rendered in the case of Edgerton vs. Electric Imp. Const. Co. in the Court of Chancery of New Jersey.

Philadelphia, Pa., through the city solicitor, has begun 10 suits in Common Pleas Court, No. 1, to recover from as many telephone, telegraph and electric light companies about $11,000 license moneys alleged to be due for the use of poles and maintenance of wires within the city limits.

PERSONAL.

Mr. Albert M. Bullard, having completed his year's service with the Electric Welding Company of England, sailed on Aug. 18 for Boston, where he intends to locate in connection with the electrical business.

Industrial and Trade Notes.

The National Electric Manufacturing Company, of Eau Claire, Wis., has secured a contract for furnishing the electric light plant to the Cook County Hospital.

The Enterprise Electric Company, 313-315 Dearborn street, Chicago, reports that the new branch office in St. Louis is now in full operation and that business is very brisk, especially the sale of the national india rubber wire.

The New Ball Automatic Dynamo, made by the Ball Electric Company, 404 West Twenty-seventh street, is meeting with the success that every good article should and the company is very busy with orders from new and old customers.

The Stirling Company, through its Boston office, 620 Atlantic avenue, report the following sales of the Stirling water tube boilers: Total horse-power sold from Aug. 1 to Aug. 20, 6,000 h. p.; total horse-power sold since January, 1892, 33,000 h. p.

Jno. M. Clover, of Dallas, Tex., contracting and consulting electrical engineer, has moved into more commodious quarters in the Jennie Scollard Building, 360 Main street, which he aims to make the leading electrical supply house of the Southwest.

Among the many large buildings which have been recently wired with Okonite wire, the Central Electric Company reports having secured the St. Charles Hotel, which will be furnished with 1,100 lights, Okonite being used throughout.

For Alternating Currents the Cardew voltmeter is recognized as a standard switchboard instrument, while an essential feature is its equal correctness when used on continuous circuits. Queen & Co., who own the American patents, are making these voltmeters in quantity to supply the demand.

The Lowell Manufacturing Company, Limited, of Erie, Pa., has issued a very convenient little catalogue describing the "Niagara" dynamos and motors, which are now so widely known. This company also manufactures a very excellent form of low tension arc lamp for use on incandescent lighting circuits.

Queen & Co., Philadelphia, have laid in a big stock of Deprez-Carpentier ammeters and voltmeters. These instruments are strictly dead beat, so that reading can be taken very quickly, and the scales are graduated from zero up. Being mounted in compact nickel-plated metal cases, they are adapted for portable testing as well as for switchboards.

Silver and green are the artistic colors on the cover of the interesting new catalogue of the Kolon Primary Battery just issued by Mr. Converse D. Marsh. The popularity of the "Kolon" is rapidly broadening, substantial orders from India, South America and Mexico being reported for the past week, while the domestic demand was the largest yet booked.

The Electric Appliance Company, of Chicago, is placing upon the market a device which promises to become very popular among electrical and street railways generally. It is known as the Schuttler ratchet drill. It is a new track drill, its special feature being that a continuous rotary motion is produced by a powerful ratchet action.

The Edward P. Allis Company, of Milwaukee, have secured the contract for 14 Reynolds Corliss engines, having an aggregate of 20,000 h. p., to be used by the Brooklyn Electric Street Railway, and to cost $440,000. In addition $90,000 worth of extra castings have been ordered. This is said to be the largest contract for stationary engines ever given.

Messrs. Harig, Koop & Co., Louisville, Ky., after experiencing more or less trouble from rust and scale in the mud drums of their boilers, applied with great success graphited oil, purchased from the Joseph Dixon Crucible Company, Jersey City. The mud drums were cleaned out and the graphited oil applied with swab-brush or anything handy to the joints and parts where the water enters the drums. Every four or six weeks this process is repeated with the most gratifying results.

The National Water Tube Boiler Company, of New Brunswick, N. J., has just completed a shipment of its boilers to the United States Electric Lighting Company, Washington, D. C. Fifteen large freight cars were required to transport the boilers. This steam plant will be a duplicate of that furnished the same company last year, and when erected the full boiler plant will be among the largest in use in electric light stations in the country.

The Berlin Iron Bridge Company, of East Berlin, Conn., will design and build the new building for the New Orleans and Carrollton Railroad Company, at New Orleans, La. The power house is 83 feet wide × 130 feet long, with brick walls and an iron roof. The car shed will be built entirely of iron, 130 feet wide × 140 feet long. It is the intention of the New Orleans and Carrollton Railroad Company to have the finest electric railroad plant in the Southern States.

The Carpenter Enamel Rheostat Company now has its works, at Bridgeport, Conn., in full operation. The many good qualities of this rheostat have been the cause of unexpectedly large business, although the works have only been in operation a short time. Orders have already been received from over fifty different concerns, one order alone being for one thousand rheostats. The capital stock of the company is $100,000 fully paid. The officers or the company are H. Ward Leonard, President; George H. Finn, Vice-President; Charles E. Carpenter, Secretary and Treasurer.

The Shultz Belting Company, of St. Louis, is distributing to its customers a handsomely framed picture of its factory, which is beautifully situated and covers many acres of ground. That the Shultz company is well represented in New York and vicinity by its agent, Mr. A. B. Lawrence, the following sales go to show: Citizens' Electric Light Company, Far Rockaway (L. I.), N. Y., one 8-inch dynamo belt; Boonton Electric Company, Boonton, N. J., one 9-inch dynamo belt; Delhi Electric Company, Delhi, N. Y., one 12-inch and one 10-inch dynamo belt; Astor Building, 9 Pine street, New York City, N. Y., one 10-inch dynamo belt; International Navigation Company, Jersey City, N. J., one 6-inch dynamo belt; New York Industrial Exhibition Company, New York City, N. Y., one 30-inch dynamo belt; laboratory of Thomas A. Edison, Orange N. J., one 9-inch dynamo belt; New Mexico Electric Company, New Mexico, 200 feet 15-inch dynamo belt; Mather Electric Company, Manchester, Conn., two 6-inch dynamo belts; Elizabeth (N. J.) Light, Heat and Power Company, one 52-inch three-ply belt, one 18, 16 and 14-inch double belt and two 8-inch belts; Stamford Electric Light Company, Stamford, Conn., one 34-inch three-ply belt.

The Crocker-Wheeler Electric Company, on account of the growing demand for special voltages differing from the three great standards, have gone into the manufacture of machines to transform direct current from one potential to another, so that now the alternating current cannot claim that advantage as being peculiar to itself alone. These transformers or motor-dynamos, one of which was illustrated and described in THE ELECTRICAL WORLD of March 19, 1892, resemble motors or dynamos in all respects, except that the electrical parts are in duplicate. One side of the machine is devoted to receiving the current from the standard source and after transformation the other side distributes it at the potential desired. It is often customary for shops which do silver and gold plating in moderate amounts to take their current, which must necessarily be of large amperage, from 110 volt Edison mains, cutting down the voltage by means of large incandescent lamps. They are thus paying for their current at 110 volts when they are only using two or three volts. By the use of a direct current transformer a consumption of 10 amperes in this manner would be reduced to about ¾ of an ampere, saving thereby from 90 to 95 per cent. of the expense. Many other instances might be named where the economy and convenience of this system is evident. The Crocker-Wheeler Electric Company, New York, is now making these machines in sizes from type 1/6 to 3 h. p., the smallest size taking current at the motor end at from 230 to 6 volts and delivering current at dynamo end at from 6 to 230 volts.

Business Notices.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Lamp Factory for Sale.—An incandescent lamp plant of modern construction, now running with a capacity of 600 lamps a day, can be purchased outright, or an interest in same secured at a reasonable price. A rare chance for a good investment is here offered. Address HIGH EFFICIENCY,
465 "The Rookery," Chicago.

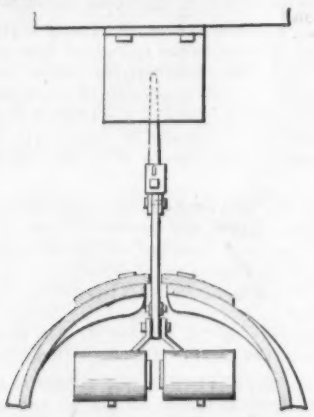
Every Electrical Student and Practical Engineer Should Have One.—Mr. J. A. Kammerer, of The Royal Electric Company, Toronto, Ont., states the following regarding "Houston's Dictionary of Electrical Words, Terms and Phrases:" "I have received the new edition of Houston's Dictionary, and am very much pleased with it indeed. I think it is a book that should be on the table of every electrical student, as well as the practical engineer. I would not part with mine for ten times the amount if I could not get another."

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS

In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

U. S. PATENTS ISSUED AUGUST 23, 1892.

481,204. Plug Spring-Jack; Christopher A. Shea, Boston, Mass. Application filed April 23, 1892. In a portable device for connecting or engaging electrically charged line terminals, a plug or terminal engaging device, a flexible conductor, a circuit-breaker between the conductor and the engaging device, and a support or holder for a supplemental or additional testing-plug or circuit breaker.



No. 481,401.—TROLLEY FOR ELECTRIC RAILWAYS.

481,220. Electric Motor and Generator; Charles S. Bradley, Avon, N. Y., and J. J. Wood, Fort Wayne, Ind. Application filed Aug. 22, 1891. A multipolar magnet for a dynamo-electric machine or motor, comprising a series of laminated rings having projecting pole-pieces, the outer layers of the ring having their polar projections bent outwardly, so as to retain the magnetizing coils in position. (See illustration.)

481,246. Thermal Cut-Out; Albert P. Seymour, Syracuse, N. Y. Application filed March 21, 1892. The object of this invention is to provide an electric wiring fixture or junction device of the kind described in which the porcelain or similar insulating base or block shall be adapted to striking up or molding in a single piece by direct pressure.

481,281. Circuit Changing Apparatus; Almon D. Page, Newark, N. J. Application filed May 14, 1892. A circuit changing apparatus having in combination contact devices, the distance between which can be varied at will, a body having a conducting section against which the contact devices are adapted to bear simultaneously, and means for producing relative motion between the contact devices and body. (See illustration.)

No. 481,457.—INSULATOR.

481,284. Telephone; Adolf Rettig, Sarbrücken, Germany, application filed Feb 17, 1892. The improvement in telephones and microphones, consisting in the combination, with a wooden case or head, of a plurality of diaphragms of different area, lever and spring devices connecting the diaphragms with each other, and screw studs and spiral springs thereon connecting the diaphragms with each other and with the wooden case.

481,291. Electric Water-Heater; Thomas Ahearn, Ottawa, Canada. Application filed April 9, 1892. In an electric water-heater, the combination of an insulated open water-tight vessel, a coil of refractory wire or strip of low electric conductivity, having its terminals connected by leads passing through the insulators, and a containing vessel lined internally with a layer of non-heat-conducting material and large enough to form an annular space around the inner vessel, and affording space for a thick layer of non-conducting material at the bottom.

481,293. Arm-Rest for Telephones; Joseph R. Bailey and Levi C. Lincoln, Woonsocket, R. I. Application filed Jan. 25, 1892. In an arm support for telephone operators, the combination, with the shoulder rod, of a vertically movable bracket journaled thereon and carrying a ratchet lever adapted to engage the shoulders of the rod and a suitable rest secured to the bracket.

481,297. Electric Switch; John H. Clark, Boston, Mass. Application filed Sept. 29, 1891. One part of this invention consists of a movable switch member, a freely suspended weight, a connection between the member and the weight and a movable pulling point introduced into the connection intermediate the weight and movable switch member, whereby the direction of pull of the weight with relation to the member may be changed.

481,381. Mast Arm; Augustus Wright, Providence, R. I. Application filed Oct. 14, 1891. In a mast arm, the combination, with a tubular frame formed by the fitting and side stays and a cross arm secured to the butt ends of the stays of an upper stay, secured to the outer end of the frame and supporting it, a tension trolley for depressing the outer end of the mast arm, adapted to support a lamp carriage, and means for operating the carriage as described.

481,386. Electric Elevator; William Baxter, Jr., Baltimore, Md. Application filed July 19, 1888. In an electric elevator system adapted to a current of constant strength, the combination, with the moving car, of an electric motor wound in series, four insulated electric conductors inclosed in a flexible cable, having one end attached to the car, a switch on the car, having contacts connected respectively with the commutator brushes of the motor, one of the terminals of the field coils, and one pole of the generator and a movable connector in the switch adapted to vary the course of the current through the motor and to thereby vary the movements of the hoisting mechanism.

481,401. Trolley for Electric Railways; Wilton F. Jenkins, Richmond, Va. Application filed Sept. 5, 1891. The combination, with the car-body having forward and rearward bearing-surfaces for the trolley connection, of the trolley-carriage running upon conductors, a subjacent conduit, and a jointed arm connected to the trolley-carriage and arranged to move transversely to the car into or out of the space between the bearing surfaces. (See illustration.)

481,402. Trolley for Electric Railway Conduits; Wilton F. Jenkins, Richmond, Va. Application filed Sept. 5, 1891. A slotted and reversible drag link or bar, combined with and hung to a trailing trolley, subjacent conductors supporting the trolley, and a transverse bail or axial connection passing through the opening of the drag link, and free to move vertically therein and connected to the car.

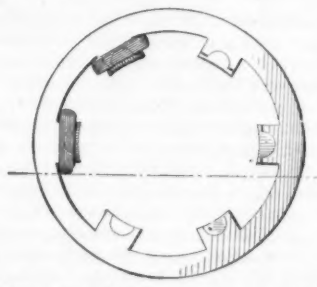
481,403. Conduit for Electric Railways; Wilton F. Jenkins, Richmond, Va. Application filed Sept. 5, 1891. A tubular slotted conduit having a series of transverse reinforcing ribs arranged internally near the slot and externally throughout the other portions of the conduit, in combination with slot plates applied externally to the conduit on each side of the slot.

481,430. Circuit Controlling Apparatus; William W. Iater and Harry C. Barnes, Oakland, Cal. Application filed Oct. 24, 1891. A pneumatic track instrument actuated by passing trains, a chamber with a piston and rod, a pipe connecting the track instrument with the chamber, whereby the vibration of a column of air is communicated from the track instrument to the chamber to move the piston therein, and the locking and unlocking mechanism of an interlocking relay, mechanically actuated by the movement of the piston.

481,457. Insulator; Arthur J. Wylie, Rome, N. Y. Application filed Jan. 18, 1892. In an electric wire or cable hanger, a non-conducting block or bracket provided with a rounded off standing portion having a longitudinal wire perforation or chamber extending entirely therethrough, and longitudinally disposed slots extending in a straight line through the front face thereof and opening into the wire chamber, and a tubular partition extension forming a continuation of the wire perforation or chamber. (See illustration.)

481,474. Magnetic Separator; Gurdon Conkling, Glens Falls, N. Y. Application filed July 23, 1891. In a magnetic separator, the combination of an inclined frame having two opposite drums, one of which is made in three sections, an endless belt passing around the drums, and magnets supported by the frame within the belt and provided with recesses to receive the rims of the sections of the upper drum.

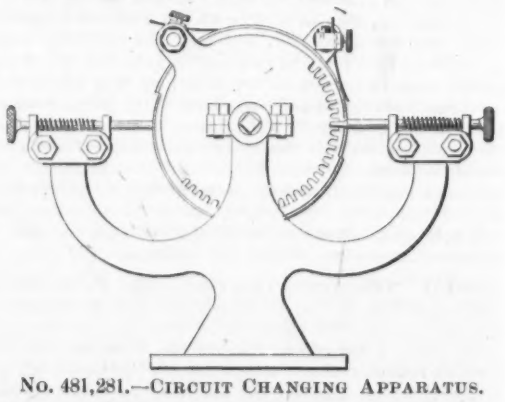
481,483. Telephone System; Richard N. Dyer, East Orange, N. J. Application filed Oct. 30, 1890. The combination, with a telephone transmitter, of a current supply in circuit therefor, a loop from the supply circuit to the transmitter and including same, an electromagnetic resistance in the loop, constituting also, the primary helix or helices of an induction coil for sending call signals, and a circuit controller for alternately making and breaking circuit of the loop at a point between the transmitter and the electromagnetic resistance.



No. 481,220.—ELECTRIC MOTOR AND GENERATOR.

481,503. Trolley Switch; Jacob S. Merkins, Highlands, Colo. Application filed Oct. 17, 1891. The combination, with the main branch overhead conductors, of the trolley switch, consisting of a suitably supported plate, and each provided with two stationary track flanges, and a suitable spring actuated piece located in a slot formed in each plate and carrying the depending guide and track flanges, the flanges of each plate being so arranged and connected with each other and with the conductors that the trolley of the car moving in one direction keeps the main conductor after passing the plates, while the trolley moving in the opposite direction passes to the branch conductor after passing the first plate and back to the main conductor after passing the second plate.

481,517. Trolley Protector; John Walsh, Cleveland, O. Application filed Dec. 23, 1891. In a device of the character described, a support having a drum and sprocket journaled therein, driving connection between the drum and sprocket, a support having journaled therein a shaft carrying a sprocket, and a disc having a notch in its periphery, driving connection between the sprockets, a spring having one end attached to the driving connection between the sprockets and its opposite end fixed to an immovable object, a catch, which normally engages the notch in the disc, and means for disengaging the catch from the notch.



No. 481,281.—CIRCUIT CHANGING APPARATUS.

481,529. Telephony; John W. Gibbony, Lynn, Mass. Application filed Feb. 8, 1892. The method of transmitting speech, consisting in passing over the line waves of alternating current or varying current of slight audibility in the receivers and superimposing thereon waves of current corresponding to vocal waves.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.